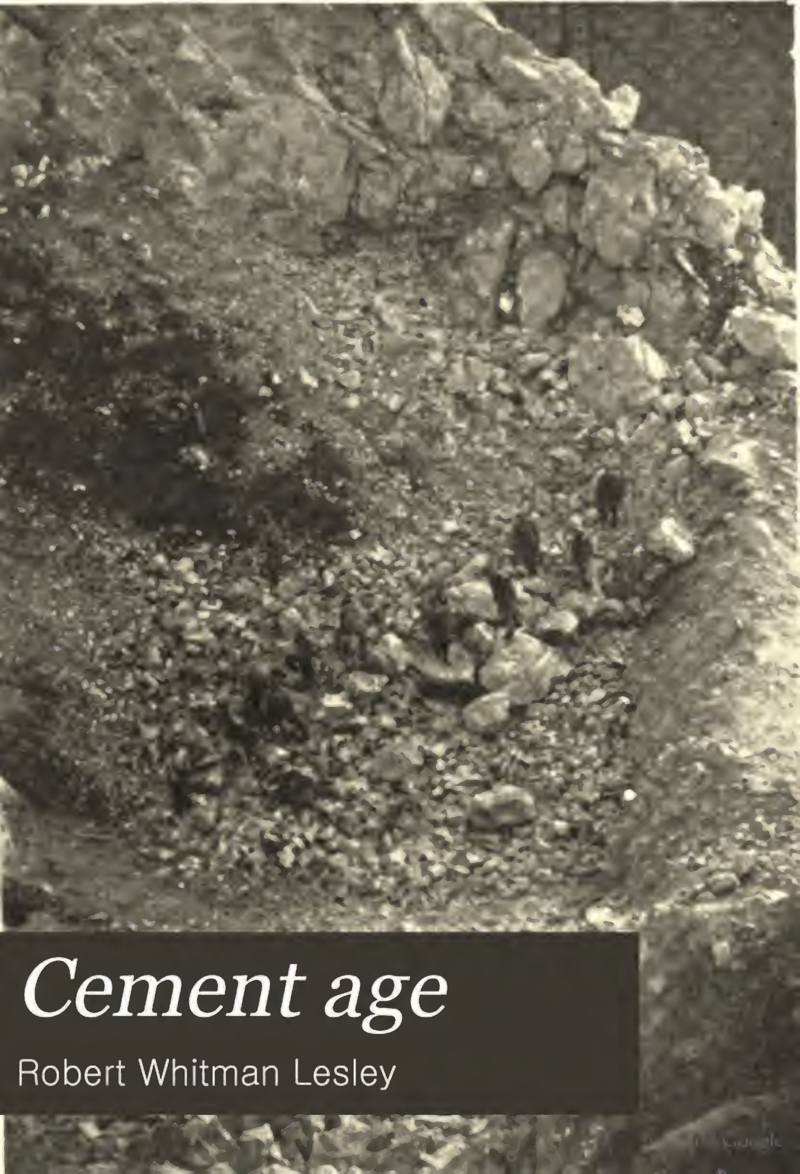

Cement age

Robert Whitman Lesley

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In preparing the index for this volume, we have endeavored to make the subject matter accessible under the best known heads. As practically every item deals with cement or concrete in some way, there has been no attempt to index under "cement" or "concrete." There is no classification under "tests" or "testing," and in general none under "design" or "construction." Look directly for the subject.

"(E)" indicates that the item is found in the Editorial Department, "(Con.)" in Consultation, "(Cor.)" in Correspondence, "(Sum.)" in Summary of Cement and Concrete Literature, "(Briq.)" in Briquettes, and "(F. N.)" in Foreign Notes. Illustrated articles are followed by (*).

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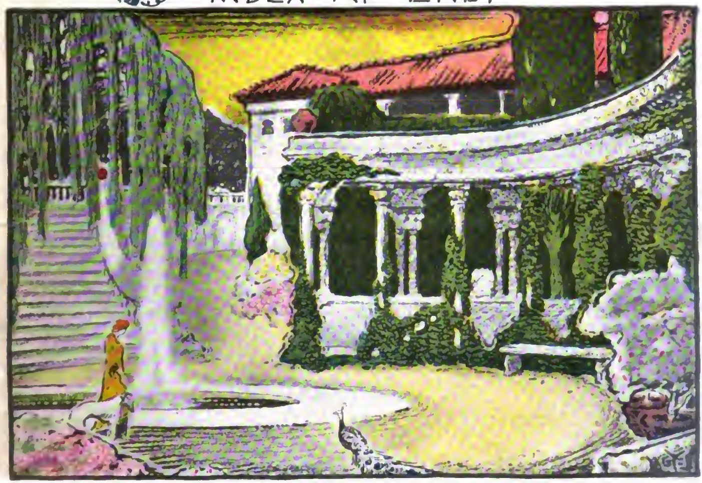

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Alphabetical Index to Advertisers on Page 44

THE CATSKILL AQUEDUCT; TYPICAL CUT AND COVER CONSTRUCTION IN DEEP CUT IN FIRM EARTH.

This shows the different stages in construction. The completed invert is shown in the foreground. This carries the track structure on which the forms are moved. The interior form with the bulkhead is then shown, followed by exterior forms in place, and concreting is in progress. Behind this is a completed section being refilled. A locomotive crane is used to handle concrete which is brought from plant in buckets on dinky train of flat cars.

Note here the efficiency in the mechanical handling of concrete. Comparatively few men are handling a very large yardage of concrete. The cement required for the entire work totals 7,500,000 barrels. This work is described further on page 8 of this issue.

CEMENT AGE with which is combined CONCRETE ENGINEERING

A Monthly Magazine Devoted to the Uses of Cement and Concrete

VOL. XIV JANUARY, 1912 *No. 1*

REINFORCED CONCRETE FROM THE INSURANCE STANDPOINT

WE clip the following from the editorial pages of *Insurance Engineering* for November:

Writing on "Why do reinforced concrete buildings fail?," in *Engineering News*, Ernest McCullough, a civil engineer of Chicago, makes startling statements which, apparently, are based on personal knowledge. "A great many reinforced concrete structures," he says, "are being erected of which engineers have little or no record, due to the wholesale education in the use of reinforced concrete given by the cement companies and companies manufacturing reinforcement. * * * The worst failures are not in the minor structures, but in the expensive ones where 'concrete experts' (?) slaved night and day over the design, to skin it and save wherever possible, to prove to owners that reinforced concrete is cheaper than steel fireproofed." Perhaps that is why the fire underwriters have proceeded so slowly in considering the advisability of giving their general approval to reinforced concrete for building construction. The experience gained by Engineer McCullough from personal investigations of failures "has shown him that in 60 per cent of the cases the design was so faulty that only exceptionally good workmanship delayed the failure;" that "in about 30 per cent of the cases the work was defective enough to be a large contributing cause, but good enough so that if the design were all right the failure might have been long delayed;" and that "in about 10 per cent of the cases the workmanship was so poor that the question of design did not have to be considered until re-building was begun, and in about half of these cases there had to be a new design." The owners of many reinforced concrete buildings have accepted the statements of engineers to the effect that such buildings will in themselves prevent the destruction of whatever is put into them and have not provided any more apparatus for extinguishing fires than is demanded by law, and if that matter is not regulated by law, as in suburban districts, no fire apparatus has been provided. If poor workmanship and poor engineering have been general, it is not unreasonable to expect fire to make as short work in destroying reinforced concrete structures, as buildings of any other type.

From at least two points of view this editorial is quite interesting. First, it emphasizes the fact that the human mind, even where it is supposed to be specially trained and unbiased, will sometimes calmly accept a situation to which it has long been accustomed, while manifesting undue anxiety concerning that which is novel or new. For example, if Mr. McCullough's statements concerning reinforced concrete failures are "startling," considered from the fire-resisting point of view, the knowledge of present conditions as they pertain to ninety-nine buildings out of every hundred should be appalling So far as we know reinforced concrete buildings represent the only type that has passed through the intense heat of conflagration without being destroyed or seriously damaged. *And yet, so to speak, we sit among the smouldering ruins of a Baltimore or San Francisco, with the very horizon obscured by mountains of junk and debris in the form of charred timbers, twisted metal and crumbled walls of brick, hollow tile and stone, and become "startled" when we hear that concrete failures, when they occur, which is very infrequent, are caused by bad design or poor workmanship.* And when we recover from the shock imparted by the knowledge that a badly designed and badly built concrete structure may not be safe, we go right along duplicating the brick, stone and tile structures that collapsed in the great conflagrations to which we have referred. In every large city and town in the United States people occupy as residences or business places veritable fire traps, and even imposing structures, that would not endure an hour under stress of conflagration. Such structures are permitted to stand and new buildings of like construction are going up every day. It is strange how easily some people are "startled" upon the subject of concrete. They found the situation startling when it was recently shown that a reinforced concrete building had, under peculiarly adverse conditions, been damaged by electricity, a very unusual and isolated case, but received with equanimity the statement of an engineer to the effect that *if reinforced concrete was in danger from electrolysis our great steel skyscrapers with their continuity of metal might be in infinitely greater danger.* On both these points, but especially that of fire-resisting qualities, concrete may well challenge comparison with other materials, for, as stated above, its record under practical test is the best we have up to date.

But the layman not informed upon the subject of concrete would, on reading the editorial quoted, have very good reason to conclude, as our esteemed contemporary has evidently done, that "poor workmanship and poor engineering have been general" in reinforced concrete construction, due to unscrupulous engineers who not only "skin" their buildings in plan, but play upon the credulity of simple minded owners to the extent of making them believe that combustible material will not burn in

a concrete building owing to some mysterious property of cement. This might fit some isolated case, for in the engineering profession as in law, medicine or even the expounding of the Gospel, individuals may be found willing to ignore every ethical standard in the interest of pecuniary gain. But Mr. McCullough had in mind concrete *failures*. His percentages have to do with *causes* where buildings have *collapsed*, and do not apply to *all buildings erected*, and nowhere does he indulge in adverse criticism of concrete or responsible members of his profession who are making a specialty of reinforced concrete construction. On this point we feel that our contemporary, in justice to Mr. McCullough and the engineering profession, should have presented Mr. McCullough's real convictions as to the worth of concrete and the causes of failure, which are set forth in the following paragraphs taken from his article:

"The reasons for the failures are not inherent in the use of concrete as a structural material. The same lack of care and exhibition of incompetency would result in failure of any structure, no matter what the material. The country is overstocked with young fellows who have specialized in the mechanics of the material, but without sufficient experience in structural design, and the fault lies with the men who employ these boys to do men's work at boy's pay. Perhaps here is the real seat of the trouble. It certainly is not due to the material, for it has been too well tried to lead us to believe it to be inferior to any material when properly handled."

In brief, Mr. McCullough, instead of disparaging concrete, has performed a real service that will be appreciated by engineers and cement manufacturers alike in calling attention to the situation described in the brief paragraph quoted.

In conclusion take the statement of *Insurance Engineering* that "perhaps this is why the fire underwriters have proceeded so slowly in considering the advisability of giving their general approval to reinforced concrete." Do insurance interests feel uncertain about concrete? If fire underwriters are withholding approval of concrete it will be news to many, especially in the light of recent developments. At the last convention of the National Association of Cement Users, E. T. Cairns, of the National Fire Protection Association, referred to the report of the National Association's Insurance Committee as the best any engineering body or association had ever presented. Following this the committee quoted the following statement in regard to reinforced concrete construction from the President of one of the largest insurance companies:

"City risks not ordinarily open to competitive rates on account of outside exposures may be brought into the competitive class by this method of construction, which will enable the property to be thoroughly protected against outside exposures.

"Under this form of construction it is practicable to have all manufacturing processes and the storage under one roof, making the factory self-contained and more economical in operation. On account of superior construction special hazards can be thoroughly cut off and protected. The storage of goods or material specially subject to water damage can be rendered practically immune, as floors can be made practically water tight.

"Owing to the superior construction, many classes of risks may be placed in the competitive class that would not be considered under other types of construction.

"This method of construction results in a decreased cost of the sprinkler equipment, as it is necessary to protect only the contents of the building and not the building itself.

"In buildings of this character with a non-combustible occupancy sprinkler equipment can be entirely eliminated, thereby saving the expense of at least 5 cts. per sq. ft. of the entire floor area."

Thus we fail to find in Mr. McCullough's article or the statements quoted from insurance experts anything that suggests doubt or disapproval of reinforced concrete, much less matter of "startling" import.

COSTLY COMPETITION

IN other columns of this issue will be found comment on the practice of "quantity surveying." Along this same line, Sir Henry Tanner, an English authority on structural subjects, points out the necessity of disassociating competitive designs and bids for reinforced concrete. When reinforced concrete is about to be used, it is the current practice of English architects to ask various firms of specialist with only the general drawings, to submit complete designs, accompanied by formal bids for the work. The preparations of these designs and estimates requires a great deal of technical work, most of which, to all intent and purposes, covers the same ground, and is, consequently, useless, as only one design can be used. In comment on this, Sir Henry Tanner says that there is absolutely no justification for this needless multiplication of unpaid work.

It is unfair to specialists, raises the cost of work all round to the architect's client, and directly leads to the acceptance of low priced inadequate work to the exclusion of the sound work demanded by the designs of the best firms. The architect certainly should not ask more than one firm to submit plans for any given building, and having obtained the scheme he can at the proper time invite competitive tenders.

In considering this matter, we must recognize that, under our present conditions, the design of reinforced concrete structures is to some extent, in the hands of the constructing specialist and the companies handling various forms or systems of reinforcement. This is true of American as well as English conditions; and has been, we believe, more true in the past than in the present, for as the industry develops, it requires the services of

design specialists, who have nothing to sell except there designing ability.

Sir Henry Tanner probably overlooks the fact that the wasteful duplicate technical work is under present conditions, really a *selling cost*, and the design is the direct auxiliary of the selling end, whether it is a material, or contracting services. Duplicate effort, however, is waste, which can not but be a factor in increasing the final cost to the consumer. The industry, in its early development, could not support design specialists. Moreover, the problems of design were ultimately correlated to the problem of construction. The engineer was in the field, and the office served the work. As a consequence of this, the best ability in technical experience was probably found in those men who were actually doing the work, either as constructing engineer, or engineer salesman.

Conditions are changing and today we find numerous firms of designing specialists, and many architects are equipped to handle the structural features of concrete. Sir Henry Tanner suggests that architects ask for only one design, and base other bids on that. It seems to us that a better plan was suggested by a correspondent in the December, 1908, issue of CONCRETE ENGINEERING. Such a method should require but one design, and that based on standard practice. The suggestion follows:

In the development of reinforced concrete, we must work toward standard methods, following the lines of structural steel. Today a complete set of drawings contain a steel framing plan by which the structural steel estimator can take off quantities and sizes of his material without requiring and applying engineering knowledge, and the manner in which this opens the way for steel estimates is very evidently to the advantage of the owner.

Applying the same procedure to reinforced concrete, a framing plan for such floor construction would require to show the following points only:

1. Size of girders and beams. 2. Thickness of slab. 3. Square inches of steel in tension, (percentage to take contraflexure). 4. Square inches of steel in compression in girders. 5. Square inches of steel in diagonal tension. 6. Square inches of steel per lineal foot of slab, percentage in distributing rods.

A framing plan containing this data, together with complete specifications, should insure an absolute uniform basis on which to estimate reinforced concrete work and would also serve as a check on the work during its execution. In the very nature of things reinforced concrete should become and will become the standard constructional material and we should work toward this end.

NEW YORK BUILDING CODE

IN the last few days of the past year, and during last session of the expiring Board of Aldermen, every political effort was made to pass the Building Code. The suggestions which Mayor Gaynor made last summer, and which had held up the code until the present time, had apparently been complied with, and the code was rushed through the printer, and with scarcely thirty hours time to study, was brought to a vote at a special meeting December 29.

The only matter of interest to record here is that the code was defeated, and that its possibilities of danger to the fair use of concrete is ended. On the floor, during the roll-call vote, the brief speeches were passionate. The fact that fire and load tests, which the concrete interests have repeatedly demanded, and which former Mayor McClellan insisted upon two years ago, had not been made, was brought up. That code requirements should be based on test data was a statement that the interests opposing concrete could not combat.

The present proposed code has been defeated, and the field is clear now, with the incoming Board of Aldermen to pass a code that will be at least fair to concrete. Attention is called to the publication, elsewhere in this issue, of the uniform regulations covering reinforced concrete, adopted by all the boroughs of New York. This went into effect January 1, and will govern concrete construction until a code is adopted.

May we say here that we believe that concrete will win the fight, because we are in the right. The concrete interests are not seeking to disbar any material, or to enfranchise any one system of construction. Fair and unbiased consideration, based on the best engineering and structural tests, theory and experience, alone is asked for. Fair play to the engineer and builder makes for the ultimate good of the people.

THE "CONTROL BEAM" FOR TESTING CONCRETE

WE were fortunate, in being able to present in the November issue a discussion of Dr. Von Emperger's "control beam" for determining the quality of concrete. Requiring practically no apparatus, and in operation essentially practical and simple, this process, by encouraging careful analytical study of the qualities of concrete, and by its facility inviting such study, deserves the careful consideration of American concrete engineers. Any suggested methods which not only add to our intimate everyday knowledge of actual everyday field concrete, but brings this knowledge within the reach of the men who are actually doing the work, and vitally need this intimate analytic knowledge of concrete, means much to the up-building of those *better methods*, which make for *better concrete*. Attention is directed to the comment on this by E. L. Ransome, in the Correspondence Department of this issue.

REINFORCED CONCRETE FISH STAND

A very interesting piece of reinforced concrete work has just been completed at Bridlington; this is a cantilever platform which is carried out from a retaining wall at the north end of the harbor and is being used as a fish stand. It was a somewhat awkward piece of engineering work, for the old retaining wall had been badly built, and the concrete backing used in its construction was of a very poor quality.

In order to put as little stress as possible upon the wall, it was decided to construct a mass concrete wall at the back of same for a depth of about 5 ft. below the road level, and to carry out from this a reinforced concrete slab projecting 8 ft., and supported by brackets which are 5 in. in thickness, and spaced at 6 ft. 2 in. centers. The brackets and slab are of 4 to 1 concrete, the mass concrete wall being 6 to 1. The slab diminishes in thickness from 8 in. to 4 in.

The platform is 50 ft. in length, iron railings surround it, and the aggregate for the concrete consisted of fine sea gravel capable of passing through a ¾-in. ring, and sea sand.

The work was executed to the author's entire satisfaction by the Chain Concrete Syndicate, of Leeds; the reinforcement consisted of ¾-in., $\frac{7}{16}$-in. and ½-in. rods, and special clips which are the patent of the firm named.

On the completion of the work in December

FIG. 2—VIEW OF UNDERSIDE OF REINFORCED CONCRETE FISH STAND AT BRIDLINGTON.

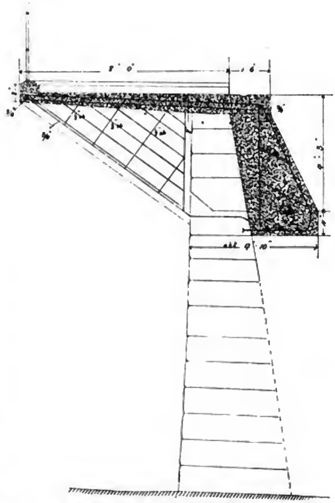


FIG. 1—SECTION OF REINFORCED CONCRETE FISH STAND AT BRIDLINGTON.

last a test load of 1½ cwt. per sq. ft. was applied at the two end bays, and the deflection caused by the load was scarcely perceptible.

This is an example of the use of reinforced concrete in work of a somewhat unusual character. It is doubtful if any other material would have made so satisfactory a job.

The contract price for this work was £114 2s. 6d. ($557.00). To this, however, must be added the cost of excavation and of the iron railings and fixing, bringing the total cost up to about £135 ($656.00).

For street-widening purposes, where a road is supported on one side by a heavy retaining wall, and it is necessary to widen such a road on that side, the author does not know of a better method than that adopted by him in this particular case, and it will be understood that if a large amount of such work is to be done, the relative cost per lineal yard will come out at a much less figure than in the case of this cantilever platform.—*Concrete and Constructional Engineering.*

Catch-Basin Heads

In Newark, N. J., E. S. Rankin, engineer of sewers has used concrete heads for catch basins. They look and wear as well as granite, and cost about $20 less.

THE QUANTITY SURVEYOR

IN a recent editorial, the *Southwest Contractor* of Los Angeles, points out the present unnecessary cost of time and effort in "figuring plans," and suggests that the English custom of having a "surveyor" take off the quantities for all bidders, be adapted to our needs. The suggestion opens up a new possible field of professional work, and merits careful consideration:

Bending over a set of plans for a large building, a contractor who is accustomed to figure on most of the medium large buildings was carefully taking off the quantitative estimates of the beams, columns, walls, etc., with the help of an assistant. The columns of figures had already reached a total length of several feet and this comprised only a part of the full amount of quantities involved. To figure this particular set of plans means about a good month's work. There are at least nine contractors figuring these plans, of whom of course but one can get the contract; hence approximately eight month's time is to be wasted by the unsuccessful contractors, the greater part of which was spent not in actually making up their price for the work, but in the preliminary work of determining how much material is required before they can obtain their figures from supply men on the cost of the material.

This incident is related to indicate wherein a vast improvement may be made in the system under which contractors must work. Not everywhere does such a time-wasting system prevail. In England, notably, the contractors are not compelled to do their own quantitative estimating. There they have what is termed a quantity surveyor, a man whose profession it is solely to take off an accurate list of quantities, and who is paid a commission in much the same way as the architect. When the architect has comoleted his plans he takes them to the quantity surveyor and obtains a detailed estimate of all materials, etc., entering into the work. This quantity survey is then furnished the contractors with the set of plans, hence the contractors are each saved that labor.

While in the Southwest it would probably be impossible to establish such a system in view of the fact that owners are adverse to paying for professional services whenever they can avoid doing so, we suggest that here is an opportunity for a bright estimator, well versed in his work and who has an established reputation, to branch out into a field of work that we believe would prove profitable not only to himself but to the contractors. He would probably not be able to obtain pay for his services from the owner, but we believe that an accurate and dependable bill of quantities would be paid for by the several contractors figuring the particular piece of work in an amount sufficient to equal the best salary paid estimators, if not more. It would amount to the contractors chipping in and paying for the services of a quantity estimator together, rather than each either spending an equal amount of time for the same purpose, or hiring an individual estimator.

Some might interpose an objection to this on the score that not all contractors use the same amount of material in a job. Where one by careful planning can put up the building with a certain amount of material, another through waste would require much more. The contractor who found that through his own lack of experience or watchfulness or through the inefficiency of his foremen he needed more material than the quantity estimate furnished him and hence had to expend more money for additional material, would learn this fact after one or two trials and govern his bid accordingly.

This plan, we believe, would work out admirably. It would serve to put the contractors on a more equal footing in making up their bids, and while by no means restricting competition, would give the owner and the architect a more dependable list of bids through eliminating one of the great chances for mistakes made by contractors. And mistakes in estimating, it is well known, have won many contractors jobs on which they have lost much money.

With uniform accurate quantity estimate on which to base their costs, contractors could the more freely bid in competition on doing the work, and would in many cases shave down their figures considerably because they would not have to add, for unlooked-for contingencies, so large a sum as the "safe bidder" does under the present system.

To successfully establish himself, the quantity surveyor would, of course, be compelled to put his work on a professional basis, for his success would depend not alone on ability but on integrity and irreproachable honesty as well.

A California Concrete Bridge in Mission Style

This bridge, at Piedmont, California, is the subject of a leading article in *Engineering News*, of September 14.

It was the express desire of the trustees that the city be given something out of the ordinary, and it was with this idea in mind that the successful plans were prepared. The old mission type of architecture was followed, a unique feature in bridge work being the introduction of four intermediate kiosks or resting places, supported by light concrete columns, and roofed in the regulation manner with Spanish *S* tile. The portals offered another opportunity for architectural treatment, and the result is four huge pylons at either end, capped with a decorative feature cast in concrete, the latte' enclosing large ornamental lights.

The total length of the structure is 362 ft. 10 in., including a central arch span of 130 ft. in the clear and symmetrical approaches. The latter are composed of reinforced slabs supported by girders and columns, all enclosed in 6-in. exterior curtain walls. Each transverse bent is made up of three columns. The roadway is 22 ft. wide, with an additional 6-ft. sidewalk on either side. The intrados curve of the arch was chosen for beauty, as well as economy. The rib was analyzed by the elastic theory, and both temperature and rib shortening were provided for. The slab of the approaches, and the arch, were designed to carry an interurban electric car, and the sidewalks were designed for a live load of 150 lbs. per sq. ft., carried by ornamental brackets rigidly connected to the arch rib and approach slabs.

Approximately 2,250 cu. yds. of concrete, and 80 tons of steel, were placed in this structure, and the contract price was $30,550, including electroliers. The average cost of the aggregate was $1.60 per cu. yd., and of the cement $2 per bbl. The cost of placing the steel averaged $9 per ton, assuming $5 per day to the housesmiths. The total cost of labor, including carpenters, concrete men, laborers, housesmiths and teams, was about $13,500. This figure is somewhat high owing to the comparatively great amount of carpentry work for this type of bridge.

NEW YORK'S WATER SUPPLY

VISITORS to the New York Cement Show will note at various points, Sixth avenue and Forty-second street, Broadway and Twenty-fourth street and other points the evidence of construction work going on underground. Derricks, compressor engines, material piles, and concrete indicate the vertical shafts by which a tunnel is being driven below the axis of Manhattan, to carry Catskill Mountain water to all of the five boroughs of Greater New York, under the East river to Brooklyn, and from Brooklyn, across the Narrows to Staten Island (Richmond Borough.) This is the distributing system of the greatest municipal water-supply enterprise ever undertaken. As an engineering work, it ranks second only to the Panama Canal.

The Catskill water supply system has been from the very first, described in detail in the various technical and engineering papers. The purposes of this present article is to direct the attention of our readers in general, and visitors to the New York Cement Show in particular, to the immensity of this project. The work at Twenty-fourth street and Broadway is adjacent to Madison Square Garden, where the Cement Show is held. This is Shaft No. 18, and the tunnel at this point is 203 ft. below the surface.

The water supply of Greater New York involved problems of prime magnitude, and the following notes on this are of interest.

For some time, special investigations were made looking toward a permanent large addition to the supply, and these eventuated in 1905 in special legislation providing for the acquirement by the city of water from four watersheds in the Catskill mountains, about 100 miles north of the city and just west of the Hudson river, having a combined available area of about 900 sq. miles. These are the watersheds of the Esopus, Rondout, Schoharie and Catskill creeks, all of which directly or indirectly empty into the Hudson. The Esopus, with an available watershed of 255 square miles and capable of supplying 250,000,000 gallons daily, is being developed first.

The present undertaking comprises the 130,000,000,000 gallon Ashokan reservoir, on the Esopus creek; the 500,000,000-gallon Catskill aqueduct, 92 miles long, from this resevoir to the city line; Kensico storage and distributing reservoir, about 25 miles north of the city of 40,000,000,000 gallons capacity; Hill View equalizing reservoir of 930,000,000 gallons capacity, at the city line; aeration fountains, at Ashokan and Kensico reservoirs; the delivery portion of the aqueduct within the city limits, and Silver Lake terminal distributing and equalizing reservoir, on Staten Island (Borough of Richmond). From Ashokan reservoir to Silver Lake reservoir the length of the Catskill aqueduct is 120 miles, and the branch into Queensborough adds 7 miles more. When the Catskill creek watershed shall have been developed, the total length of aqueduct from the farthest reservoir to Silver Lake will be 150 miles, and the total capacity of all reservoirs will be approximately 260,000,000,000 gallons, or 800,000 acre feet. The maximum number of persons employed has reached about 20,000 and the maximum expenditure for construction, in one month, exclusive of engineering, real estate and administration has been $2,150,000. At this date the works north of the city line are practically all in progress and about 40 per cent done.

All of the engineering, legal and other difficulties and problems have been met and overcome. Work is actively in progress along about 110 miles of the line and the possibility of the delivery of water into Croton Lake now seems to be only a little more than 12 months distant.

THE ASHOKAN RESERVOIR: The Ashokan reservoir, about 14 miles west of the Hudson at Kingston, is now being built under contracts amounting to nearly $14,000,000. The Olive Bridge dam, across Esopus Creek, the Beaver Kill and Hurley dikes,

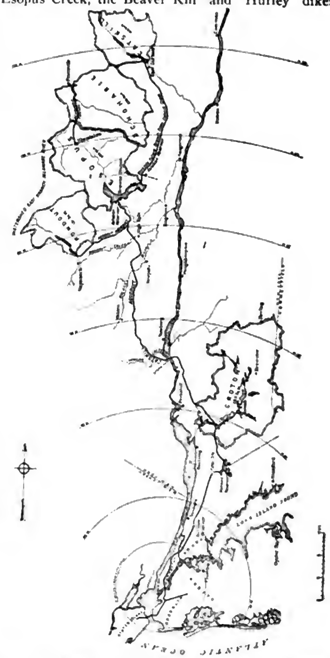


FIG. 1—GENERAL PLAN SHOWING LOCATION AND EXTENT OF THE CATSKILL AQUEDUCT.

across smaller streams and gaps between the hills, forming the natural walls of the reservoir, the dividing dike and weir dividing the reservoir into two basins, and the waste weir over which the surplus flood waters may safely be discharged, are the principal structures of the reservoir. The water which the reservoir will hold would cover all Manhattan Island to a depth of 28 ft.; the area of its surface is equivalent to that of the Manhattan below 116th Street.

Capacity	130,000,000,000 gallons.
Water surface	8,180 acres=12.8 sq. m.
Elevation of water (full reservoir)..	590 feet above tide
Length of reservoir	12 miles
Depth of reservoir, maximum, 190 ft. Average	50 ft.
Villages to be submerged.	7
Railroad being relocated	11 miles
Highways to be discontinued, ...	64 miles
Highways to be built	35 miles
Bridges to, be built	10
Earth and Rock to be excavated.....	2,468,000 cu. yds.
Embankment to be placed	8,025,000 cu. yds.
Masonary to be placed	820,000 cu. yds.
Cement to be used.	1,160,000 bbls.
Maximum number of men employed	3,000

The Kensico Reservoir:* The Kensico reservoir, east of the Hudson, and 30 miles from the City Hall, will contain several weeks' supply of Catskill water. It will act as an emergency storage reservoir, so that the supply will not be interrupted in case of inspection, cleaning or accident to the 77 miles of acqueduct between it and Ashokan. Its capacity will be 40,000,000,000 gallons, and it is now being constructed under contracts amounting to nearly $8,500,000.

The Hill View Reservoir: The Hill View reservoir is in Yonkers, at the city line, and 15 miles south of Kensico. Its function will be to equalize the difference between the use of water in the city as it varies from hour to hour and the steady flow in the acqueduct. It will also furnish large quantities of water upon immediate demand, as in a great conflagration. It will hold 900,000,000 gallons. The contract for its construction was let for $3,270,000.

The Catskill Aqueduct: There are four distinct types of aqueduct, cut-and-cover, grade tunnel, pressure tunnel and steel-pipe siphon, north of the city line. The cut-and-cover type will form 55 miles of the aqueduct, will be of horseshoe shape, 17 feet high by 17 feet 6 inches wide inside, and will be constructed of concrete. When completed it will be covered by an earth embankment. This is the least expensive type and so is used wherever the elevation and nature of the land permit. Of this type 36 miles have been built.

Where hills or mountains cross the line and it would be impracticable to circumvent them, tunnels at the natural elevation of the aqueduct are driven

*The elevation of telegraph poles to cross this reservoir is described on page 32 of this issue.

FIG. 2—OLIVE BRIDGE DAM SPANNING ESOPUS CREEK, THE MAIN TRIBUTARY OF ASHOKAN RESERVOIR.

Downstream view taken in August, 9, 1910, three years after commencing the dam was completed in 1911. It is over 220 ft. high above foundation, 190 ft. wide at base, 23 ft. wide at top, 4,650 ft. long, of which 1,000 ft. is solid masonry. Note jagged effect produced by building up between expansion joints provided every 84 ft. or so to allow for temperature changes in this huge mass. A world's record was made here in laying over 35,000 cubic yds. of cyclopean masonry in one month.

FIG. 3—DIKE CORE WALL.

Beaverkill dike for Ashokan reservoir in construction. Wooden forms with cantilevered studding are successively raised and concrete deposited between them by cableway. Earth embankment on either side sorted to remove stones and organic material is sprinkled and rolled in thin layers. At its widest part base of earth embankment is 650 ft. wide. Upstream, where exposed to wave action the dike will be protected with stone revetment. The downstream side will be sodded.

through them. There are 24 of these grade tunnels, aggregating 14 miles. They also are horseshoe shape, 17 ft. high by 13 ft. 4 in. wide, and lined throughout with concrete. Of these tunnels 11 miles are excavated.

Where deep and broad valleys must be crossed and there is suitable rock beneath them circular tunnels are driven deep in the rock and lined with concrete. There are 7 pressure tunnls, totaling 17 miles, with a diameter of about 14 feet. A shaft at each extremity connects each pressure tunnel with the adjacent portions of the acqueduct. To date over 16 miles have been excavated, including all shafts, of the total of 29 shafts.

Steel-pipe siphons are used in valleys where the rock is not sound or where for other reasons pressure tunnels would be impracticable. These steel pipes are made of plates riveted together, from 7/16 in. to 3/4 in. in thickness, and are 9 ft. and 11 ft. in diameter. They will be lined with 2 in. of cement mortar† embedded in concrete and covered with an earth embankment. There are 14 of these siphons, aggregating 6 miles. Three pipes are required in each siphon for the full capacity of the aqueduct, but only one is now being laid. Almost 5 miles of pipe have been laid.

THE CITY AQUEDUCT: From the Hill View reservoir, Catskill water will be delivered to the five

†Applied with "cement gun" as previously described in "Cement Age."

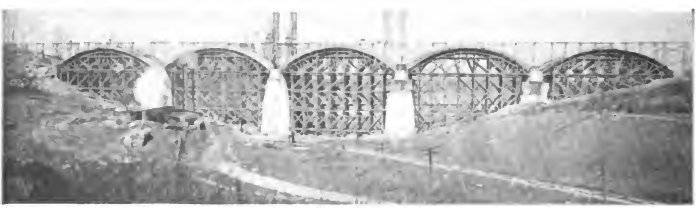


FIG. 4—RYE OUTLET BRIDGE.

A highway bridge to connect opposite shores of Kensico reservoir at its narrowest part. When the reservoir is full the water will rise to the springing line of arches, 355 ft. above sea level.

boroughs by a circular tunnel in solid rock reducing in diameter from 15 ft. to 14, 13, 12 and 11 ft. From two terminal shafts in Brooklyn steel and iron pipe-lines will extend into Queens and Richmond. A cast-iron pipe, resting on the harbor bottom, will cross the Narrows to the Silver Lake reservoir on Staten Island, holding 400,000,000 gallons. The total length of this delivery system is over 34 miles. The tunnel will be at depths of 200 to 750 ft. below the street surface, thus avoiding interference with streets, buildings, subways, sewers and pipes. These depths are necessary, also, to secure a substantial rock covering to withstand the bursting pressure. The tunnel will be constructed from 24 shafts about 4,000 ft. apart, located in parks and other places where they will interfere very little with traffic. Through these shafts, also. the water will be delivered into existing pipes. Tunnel and shafts will be lined with concrete. Contracts for the entire tunnel and portions of the pipe-lines were awarded this year and work on them is now in progress. The estimated cost is $25,000,000, for tunnel, pipe-lines and Silver Lake reservoir. The only parts of the City Tunnel work visible to the pedestrian will be at the shafts. The tunnel passes from one to another, for its whole length under streets, parks or rivers, and at varying depths.

The total cost of this work is approximately $177,000,000. The foregoing brief outline is sufficient to show the magnitude of the work. J. Waldo Smith is Chief-Engineer of the Board of Water Supply. We are indebted to Alfred D. Flinn, Department Engineer, and J. Richmond, of the Engineering Department, for notes and illustrations. The work is open for inspection by interested engineers, builders and architects. The offices of the Board of Water Supply are at 165 Broadway, New York.

In all this work, reinforced concrete is a most important factor. It would be interesting to speculate what the cost of this work would be if concrete were unknown. Under present conditions, the difficulties of accomplishing this without concrete would be practically impossible. The conclusion is that concrete makes this construction possible, and brings to the millions of a great city the pure water that makes for health and happiness.

Reinforced Concrete Buildings in Japan

[*From Consul General Thomas Sammons, Yokohama.*]

A new modern office building has been completed in Yokohama opposite the American consulate general. It was designed by a Japanese architect and is made of and furnished almost exclusively with Japanese products, the most notable exception being an American (Otis) automatic elevator. The reinforced concrete features of this structure are attracting favorable attention among builders. Representatives of the American system of reinforced concrete structural methods are now in this district and are confident of securing satisfactory results. The building is provided with a roof garden.

The Mitsui Bussan Kaisha Co., for which the structure was built, is the trading department of the famous Mitsui Industrial & Banking Establishment of Japan, which has branch offices throughout the world, its New York office being at 445 Broome street.

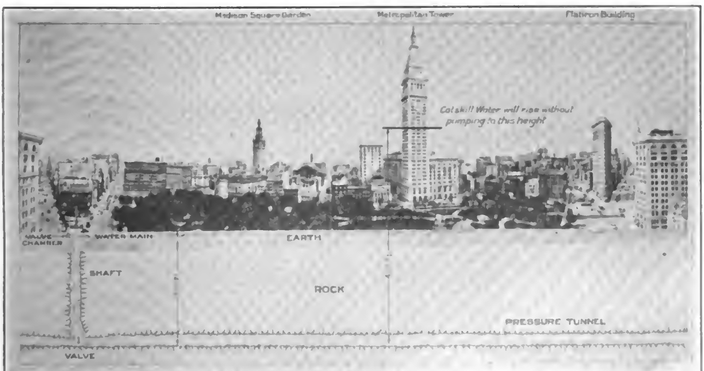


FIG. 5—CITY AQUEDUCT TUNNEL.

Typical section of Madison Square showing construction shaft and circular concrete-lined tunnel under minimum sound rock cover of 150 ft. Besides shut-off valve in tunnel, shaft-head valve chamber will contain automatic pressure regulating valves to supply existing mains with desirable pressure.

FIREPROOF RESIDENCE CONSTRUCTION

By E. S. Child*

BUILDERS who are familiar with frame construction and masons who have laid up only stone and brick are apt to hesitate before they undertake fireproof tile and concrete construction. Their lack of experience often leads them to overestimate the cost of such construction. There are certain essential points in fireproof construction which experience has shown greatly reduce the risk of fire and while it would be better to make a building entirely fireproof, the use of fireproof materials in the first floor, walls and roof is judicial and not necessarily very expensive, in proportion to the entire cost of the building. An ideal home now goes far beyond the old custom of considering only shelter and has many complicated conveniences. The writer believes that safety should always be considered in addition to conveniences which are now so carefully thought out.

All forms of construction with fireproofing as their motive have their own merits and faults, but for residence work, the writer is of the opinion that hollow tile and concrete for walls and floors is the most practical. The writer has designed several residences partly fireproof and with hollow tile walls and floors in the vicinity of New York and in every case has been agreeably surprised at the difference in the cost between this construction and the ordinary frame walls and floors.

In one residence costing about $18,000 in Greater New York, an exact estimate on both frame walls and 8-in. hollow tile walls was taken. The difference in this building, which measured about 58 ft. x 35 ft., was $329.

*Architect, 29 Broadway, New York City.

There is now being erected under my supervision at Dalton, Mass., a fine expensive residence in which we are using for the walls the "Dennison" interlocking tile†, making 8-in. walls‡. These hollow tile walls are being covered with "asbestic" stucco put on with a cement gun. This gives a waterproof stucco, as well as removing any fear of the exterior coat coming off.

The "asbestic" referred to is an asbestos sand**, and has been used extensively on stucco work. The contractors for the stucco work are the New York Cement Gun Co. The operation of the cement gun was described in detail in CEMENT AGE for April, 1911. An interesting point to note here is the density of stucco put on in this way. In placing stucco by hand, 1 ton of dry mixed material will cover from 25 to 28 sq. yds. of surface. In using compressed air equipment, 1 ton of material will cover only 14 sq. yds. Both Atlas and Edison Portland cement was used on this work.

The first story floor is made of combination hollow tile and reinforced concrete, a floor easily laid, being fireproof and of everlasting qualities.

This floor was made by placing alternately tile blocks and concrete beams. The concrete beams, being reinforced with steel rods, 6 in. x 12 in. x 12 in., tile blocks were placed on simple forms along in rows, spaced 18 in. on centers, giving 6 in. x 6 in. reinforced concrete beams between each row. Reinforced concrete girders were run the length of the building, which made the span of the beams about 10 ft. The girders are 12 in. deep dropping

†Made by the Great Eastern Clay Company, New York City.
‡Similar wall construction was described in "Cement Age" for September, 1911, page 104.
**The Johns-Manville Co., New York City.

FIG. 1—PERSPECTIVE OF FIREPROOF RESIDENCE AT DALTON, MASS.

6 in. below the ceiling in the basement. When the concrete was poured the entire floor was covered to a depth of 1½ in. over the top of the tile, making the total floor depth with the exceptions of the girders 7½ in. This depth is suitable for the ordinary floor load with a proper factor of safety. A feature of the construction is the absence of the usual massive concrete columns in the basement supporting the concrete girders. Three and one-half inch "Acme" steel shell, concrete-filled columns were used, which gives the necessary strength with a minimum of space required. The contractors for the work are the Geo. H. Lysat Co., of New York.

This floor gives a residence well protected against loss by fire. The remainder of the house is frame construction with the exception of the 4-in hollow tile wall between the rear of the house and kitchen extension wing, the additional expense of entire fireproof construction not being deemed necessary.

Fire Underwriters appreciate this fact and with a house built in this manner, they make a material allowance in the rate of insurance.

The data of the actual cost of this fireproof construction has been submitted by the contractor and it is readily seen in comparing it with the cost of frame construction, just what is the additional expense of making a house fireproof.

The following is the statement from the contractor:

Estimated Cost of the House (per square yard of exterior wall).

Frame construction.

Timber	$ .54
Sheathing	.54
Plaster on wire	1.50
Plaster on board	.50
Labor	.75
	$3.83

Fireproof construction.

Tile blocks	$1.40
Labor	2.40
Plaster and Stucco (inside and outside)	1.80
	$5.60

It is here seen that the difference in expense between the unsatisfactory and less durable frame construction and the hollow tile construction is $1.77 per square yard. On this residence there are approximately 700 sq. yds. of exterior wall surface. This makes a total additional expense for the fireproof walls of $1,239.

The cost of fireproof floor construction compared with frame construction is also given. In this house there there were 2,660 sq. ft. of first floor surface.

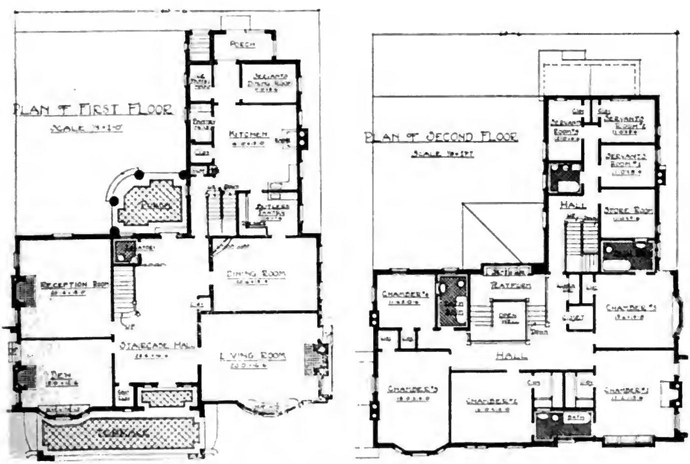


FIG. 3—FLOOR PLANS OF RESIDENCE AT DALTON, MASS.

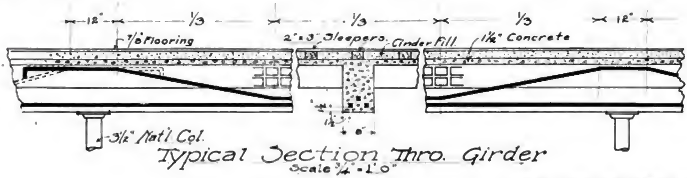


FIG. 2—FLOOR DETAILS

TOTAL COST OF FLOOR.

Estimated frame construction.

Timber	$150.00
Plaster on wire (cellar ceiling)	150.00
Labor framing	75.00
Rough flooring	135.00
	$510.00

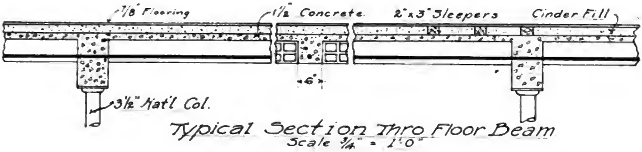
It is seen that the cost per square foot is approximately 35 cts. as compared with the cost of frame construction of 20 cts.

Fireproof construction.

Hollow tile	$154.80
Cement	78.75
Steel	135.00
Sand	50.00
Stone	70.17
Forms	150.00
Labor	95.25
Plaster cellar ceiling	50.00
Sleepers and cinderfill	135.00
	$918.97

The entire cost of fireproofing this building and

FIG. 4—RESIDENCE UNDER CONSTRUCTION AT DALTON, MASS.



IN FIREPROOF RESIDENCE.

making it durable and much more satisfactory is approximately $1,647 which is not more than from 5 to 10 per cent of the entire cost of the building.

The results, while not an entirely fireproof house, fireproof construction is adopted where most practicable to do so, which results in a residence of great durability, well protected against loss by fire, of very economical construction possessing the main advantages of hollow tile and concrete construction and costing but little more than the much less durable and less satisfactory wooden construction.

The artistic effect of this house differs materially from most stucco houses and shows the possibility of stucco for artistic homes.

POWER FOR MIXERS

AT this time when every possible effort is being made in all lines of work to obtain a higher efficiency and a lower cost of production it is surprising to find that comparatively few contractors are alive to the tremendous opportunities before them to make their margin of profit on a job more computable. Many examples might be cited where a careful investigation would result in an alteration of methods and a change in equipment, and one of the most common of these is probably the method of driving the mixer outfit.

When an analysis is made of the items affecting the "ultimate cost of power" consumed by a mixer outfit the following points stand out as the most important: (1) first cost, (2) labor charges, (3) fuel charges, (4) repair charges, (5) depreciation and interest. It is quite safe to say that not one contractor out of a hundred considers seriously any items beyond the first cost. He usually decides on the type of drive most convenient for him to use regardless if it is the most economical, all things considered.

Naturally, it will be the contractor that goes into the question deeper than this that will be more prosperous. He won't select an electric motor-driven outfit simply because it is easy to operate and takes up less space than a steam boiler and engine or gasoline engine outfit. He will figure out what his "ultimate cost of power" will be. He will find out the rates of the power company and then balance the expenses for a year for operation and maintenance against the corresponding items for a gasolene or steam engine drive. It is possible that in many cases it would be a decided disadvantage to use an electric motor-driven outfit, notwithstanding its many advantages.

Some one will say that the cost of power used by a mixer outfit is so small in comparison to other items that it is foolish to pay any attention to the kind of drive and if electric current is accessible, use a motor, if you have a steam supply, then use a steam engine, if you have not either use a gas engine.

The advantages and disadvantages of the steam, gasolene, and motor drive could be enumerated at length, but to put them briefly, it might be said that the decided advantage of the motor over either of the others is in the simplicity of operation and the small space occupied. It is readily started and stopped. The gasolene engine, while more efficient than the steam engine, is less economical, but has a decided advantage in that it requires practically no attention after starting. Equipped with a friction clutch it may be temporarily thrown out of connection with the mixer and it is not necessary to stop it. The steam engine and boiler outfit is reliable and the fuel economy is lower than the gasolene engine or motor, but requires more attention than either gasolene engine or motor, but the engineer can be used generally for other operations. The repairs to a steam engine are generally less, which is something in its afvor.

It is only by carefully considering all of these points of each drive in connection with the conditions of each job that the most economical drive can be slected. The day is passing when such decisions can be jumped at. The selection of drive should receive equally as much attention perhaps, as the selection of the mixer itself. Contractors have usually available an outfit for any form of drive so that the question of first cost does not come into the selection of the drive for a given job. It will not be long before this question of the ultimate cost of power will have more attention from contractors as it will be seen that there is splendid opportunity here for effecting economies.

Pyramidal Cap for Wall Forms

In the construction of the cellular portion of the upper approach wall at Gatun Locks, it was found impracticable to dump the concrete directly from buckets into the 18-in. forms for the walls. The method adopted, according to the *Canal Record*, is to cap the inner forms for the rectangular cell with a pyramid of heavy boards. The concrete is dumped over the apex of the pyramid and flows down the sides in an approximately equal distribution among the forms at the base. Since all the concrete falls into the continuous space between two homologous rectangles, it can be packed evenly about the inner form without difficulty. At present the concrete is dumped from 2-cu. yd. buckets by a stiff-legged derrick.

CONCRETE IN SMALL GARDENS AND COURTS

MERELY because it is a custom, most people look upon the back yard or court of city and town houses as an appurtenance set apart for the ash can and the entrance and exit of the milkman and his kind. As a matter of fact, however, many of these small spaces open to the sky and rain could be easily transformed into attractive and beautiful little gardens or retreats, as is suggested in the accompanying photographs. In days gone by the back yard shown was of the customary type, wherein reposed broken boxes and other trash. The property fell into the hands of the Arts and Crafts Guild, 235 South 11th street, Philadelphia, and the transformation followed. Nearly all of the changes effected represent a proper use of concrete. The several objects and ornamental structural details were manufactured and placed by William R. Mercer, Jr., of the Ornamental Concrete Works, at Doylestown, Pa.

To improve the appearance of the back yard grass plots were introduced and gravel walks laid out. Concrete columns surmounted by an arch of ornamental concrete work resulted in the doorway between the two courts. The arched windows were treated in the same fashion minus the columns. Wall ornaments, urns, flower boxes and columns, exact reproductions from Byzantine originals and the Renaissance period, were placed as shown. The old walls were stained with color. The decorative scheme has not been fully developed as yet, as much more will be done in the way of training vines and planting flowers.

Much has been said about the "harsh and forbidding" features of concrete, but this example of its use shows how unfounded is the charge that it cannot be made into anything really beautiful. It is not surprising that there has been complaint on this score, for concrete—and in the name of art—has been made as repellent as anything we can conceive of, but in this case it reveals another side. In the first place, the ornaments shown are copies of old masterpieces in stone. Thus selection was a most important matter. The same good taste was exercised in reproduction and the result is not a hard or muddy-looking object, but a fac-simile of things cherished in the private collections and museums

FIG. 1—A COURT AT THE REAR OF THE ARTS AND CRAFTS GUILD HOUSE, PHILADELPHIA. Concrete has transformed this from an ugly backyard into an attractive garden.

of Europe as rare specimens of art. Our good friends, the clay workers, have claimed that their products alone represent all that is best in this field of endeavor. Granting them full praise for the admirable things they have done, we find them in this instance brought into contrast with common gravel, and not to the disadvantage of the latter. Simple gravel walks, like old-fashioned lattice-work, are difficult to beat when it comes to an environment of turf and shrubbery. And it will be found, in looking at these two pictures, that the plain and economical gravel walk fits in admirably with the concrete, in fact better than the damp-looking bricks seen through the doorway in Fig. 2.

Coming back to the concrete features of the court it will interest readers to state that a new decorative process has been applied to some of them. It consists of an inlay of bits of gold and glass, the latter of the color and texture of enamel, which are placed in the depressed parts of ornaments or borders especially suitable for this purpose. In some patterns the concrete thus becomes the background and also the outline for mosaics in dull colors combined with gold.

In conclusion we feel that this example of concrete work fully meets the criticism of those who contend that it is not suitable for ornamental or decorative purposes. It is especially adapted for improvements of the kind described and the value of many properties would be enhanced from both sale and renting standpoints if treated in the manner shown.

Concrete Prevented Spread of Fire

[*Bulletin of the Universal Portland Cement Co.*]

A greasy pair of overalls hung up in a corner, perhaps with matches in the pocket, started a fire in a Milwaukee automobile body paint shop. The damage was not over fifty cents. The building was of concrete and could not catch fire from the overalls and the few sticks of wood which they ignited.

The two floors above the paint shop were given over to tailoring and over two hundred operatives had only one elevator and a stairway by which to gain the street. The fact that the building was of concrete and that there was nothing inflammable except the closely covered oils and varnish and a few wooden horses on which the automobile bodies rested, saved what might otherwise have been a duplication of the Asch fire in New York.

FIG. 2—ANOTHER VIEW OF THE COURTYARD.

The small yard or court has been transformed into an attractive garden by the use of concrete. Formerly used as a dumping ground for trash, it is now an important part of the property.

THE ANNUAL MEETING OF THE ASSOCIATION OF AMERICAN PORTLAND CEMENT MANUFACTURERS

THE annual meeting of the Association of American Portland Cement Manufacturers was held at the Waldorf-Astoria, on December 11, 12 and 13, and was very largely attended by members from all parts of the country. The Hotel lobby and the various committee rooms were filled with cement manufacturers, early in the afternoon of the 11th, and on that afternoon many of the committees of the Association held meetings, noticeably those on Cement Specifications, Uniform Cost Sheets and Publicity. Several private dinners were also given by various members to their friends, and in the evening the Executive Committee of the Association convened and received the annual report of the Association which was read by President Edward M. Hagar. The report, which was approved, was presented at the general business meeting of the Association the following day. Varions matters of interest to the trade were discussed and the treasurer's report, together with the reports of the various committees, were considered and approved.

BUSINESS MEETING: The regular business meeting was held on the morning of Tuesday, December 12, and was one of the most largely attended meetings in the history of the Association. Members were present from the south, the far west, the middle west, New York State and the Lehigh districts. The officers of the Association, namely, Edward M. Hagar, President; W. S. Mallory, vice-president; John B. Lober, treasurer and Percy H. Wilson, secretary, were re-elected, as were also the members of the Executive Committee.

Interesting reports were presented by the Committee on Publicity, the Committee on Uniform Cost Sheets and the Committee on Specifications. The subject of bag returns was also discussed.

ANNUAL DINNER: On Tuesday evening the annual dinner of the Association was held with President Hagar in the chair. Good music and clever speeches enlivened the proceedings and made the dinner the most memorable one in the history of the Association.

OPEN MEETING: Wednesday's session was devoted to the consideration of a program of important papers prepared by the Committee on Articles and Literature, and are as follows:

Summary of the Proceedings of the German Portland Cement Manufacturers' Association, Robert W. Lesley.

Accident Prevention and Relief, by Raynal C. Bolling.

Methods and Appliances for the Prevention of Accidents in Cement Plants† by J. G. Bergquist.

The first paper read relating to the German Association proceedings has been published in full in the December number of CEMENT AGE. It elicited discussion which was participated in by many of the members. The German Proceedings always awaken considerable interest and are looked forward to as a yearly event in the program of the American Association.

The paper by Mr. Bolling was of much interest.

Mr. Bolling talked informally, and after discussing the question of painting dangerous parts of machinery red, said that this was found, in the long run, to be impractical, as it was impossible, in cement mills especially, to keep the paint bright enough to be effective.

As to the question of safety vs. output, Mr. Bolling emphasized the point that safety precautions need not diminish output. It has been the experience of the steel corporation that the discipline brought into the organization by the campaign for safety has in the long run increased output for men do their work better under safer conditions.

Safety devices, he said, are not only being installed in all the new mills, but as the machinery is being replaced in the old mills, every design is passed on for safety. On the whole, conditions are better and constantly improving.

Some one brought up the question of in what proportion safety is secured by, on one hand, the installation of the best mechanical safety devices, and on the other, the discipline and interest of the operating force, from the executive down. Mr. Bolling said the personal interest of each man was vital to any success. The best mechanical safety installations are useless unless the operators are interested. The Steel Corporation, as Mr. Berquist had stated in a previous paper, has tried many means of creating, stimulating and maintaining this interest, and results are shown by the marked decrease in accidents.

In regard to workmen's compensation and employer's liability, Mr. Bolling said that the greatly increased financial burden under present and coming legislation could not be escaped by the expedient of liability insurance or anything else. The only way out is to eliminate the accident, and this, as shown by the experience of the U. S. Steel Corporation, can be done. Mr. Bolling recalled a statement made some time ago to the managers of casualty insurance companies that they had better begin to put the burden of their energies on the prevention of accidents rather than the making of cheap settlements, bcause the time was coming when accidents were going to be dealt with by Safety Commissions in the mills and not by the lawyers in the courts.

In regard to the legislation now under way in the different States, in the "50 laboratories," as Mr. Bolling called them, some legislation is good and some is poor, and employers should acquiesce to its coming, and shape it rationally, sanely and justly, rather than trying to oppose it.

Mr. Bolling pointed out the future probability of the organizations of employer's mutual accident association, very similar to the fire mutuals of New England, and that these would be probably the best solutions of the matter. The idea would be to put

†This paper is reviewed in this issue under the proceedings of the cement section of the Amer. Soc. of Mechanical Engineers, page 20.

a premium on safety installations, and encourage their use wherever possible.

In commenting on Mr. Bolling's talk, Mr. Lesley said that in Germany, where the Government, in a measure, stands a good deal of the expense incident to this question of accidents, a trade like this or a trade like the silk manufacturers is permitted to do their own insurance; in other words, exactly what Mr. Bolling has described; an industry, while it may not be insured through the form of a mutual insurance company, will, as an aggregate, divide the risk on the whole thing; in other words, the payroll of each concern will bear a charge for the accident insurance and in that way each of the mills holds up the other to the highest standard of carefulness and safety in order that the total loss divided among the trade may be reduced to a minimum.

In regard to accident relief, Mr. Bolling further said that on May 1, 1910, the U. S. Steel Corporation, not wishing to wait until it was compelled by law to apply compensation in all cases irrespective of whether it was at fault or not, announced and put into operation a system of voluntary accident relief under which every man in its employ gets a stated amount of relief prescribed for his class of employment, regardless of who was to blame for any accident, even if he himself was to blame, provided only he was not guilty of some reckless disregard for the safety of his fellow workmen or did some illegal act or some few things of that kind.

In closing, Mr. Bolling said that if any of the companies of the Steel Corporation could offer any advice or co-operation in this campaign for greater safety in the mills, the cement manufacturers were welcome to the benefits of their experience.

On both days the proceedings were closed at one o'clock for lunch and re-opened at two o'clock. Needless to say the breaking of the day by lunch and social elements was one of the features of the convention.

CLINKER CONCRETE AS A KILN LINING

An abstract of an article on the above subject taken from a German paper appears in the *Journal of the Society of Chemical Industry*, London. It states that the author has found that pure cement concrete possesses many advantages over other materials which have been used as linings for cement kilns. It has only to resist the mechanical wear and tear of the sintered cement mass which exerts no chemical effect upon it. The concrete is composed of 2 or 3 parts by weight of hard burnt cement clinker (the size of grain being from 2 to 20 mm.) and 1 or 2 parts by weight of ground slow-setting cement, and is mixed with just enough water to cause the mass to cohere when pressed together. When such freshly-prepared concrete is heated to a red or white heat, it hardens quickly, remains hard at high temperatures, and retains its form and hardness, whether heated slowly or quickly, in the sintering zone of a Dietzsch kiln in full work. The concrete begins to set in about an hour, and only about as much as can be used in that time is prepared at once. The concrete lining 20 cm. thick can be conveniently rammed into the whole length of a rotary kiln, by using an iron ring about 40 cm. smaller than the diameter of the kiln as a mold. A rim of concrete about 2-5 m. wide can be formed in a day, and ... to set over night; the next morning the molding ring is moved and a second rim of concrete rammed against the first. No special care is required in heating the kiln to its full working condition. The examination of a layer of cement concrete only 10 cm. thick, which was tried in the sintering zone of a rotary kiln for 14 days, and then cooled, showed that a thin layer of cement had formed on the concrete and split away again on cooling, and the mechanical wear and tear amounted to 3 cm.; otherwise the concrete was intact. As the molten basic cement does not act chemically on the concrete, it does not adhere as it does to a fireclay lining, except for the cohesive effect of the ash contained in the coal. A cement concrete lining will last from 3 to 6 months in the sintering zone of a kiln, and is also suitable for the end shoot, which can be re-lined with concrete in an hour without interrupting the work, whereas re-lining with fireclay necessitates stopping and cooling the kiln. The concrete answers well not only with rotary kilns but also with other types, such as the Dietzsch, and Schneider. The lining can also be composed of blocks of concrete, kept ready for use, and mortared in with cement. The cost of repairing the concrete linings is much less than that of a fireclay lining, being only about 12 to 14 m. per metre (84 cts. to $1.00 per foot), against about 230 m. per metre ($16.28 per foot) for fireclay lining, and as the former lasts longer than the latter, the repairs are less frequent. In actual practice, the cost of repairing the fireclay lining of a Dietzsch kiln amounted to 5 Pf., and of a Schneider kiln to 2-5 Pf. per barrel of cement of 170 kilos. (1.2 cts. and 0.6 cts., respectively, per barrel of 374 lb.), whereas, for these kilns the repairs of a cement lining amounted to 0.7 and 0.8 Pf. (1.6 cts. and 1.8 cts.), respectively. The process is patented in Germany and other countries, and has already been adopted in 26 works.

Production of Sand and Gravel

More than $21,000,000 worth of sand and gravel was dug for sale in the United States in 1910. According to a report by Ernest F. Burchard just issued by the United States Geological Survey, the production of glass sand, other sand, and gravel in 1910, was 69,410,436 short tons, valued at $21,037,630 against 59,565,551 short tons, valued at $18,336,990, for 1909.

The following table shows the tremendous increase in production of sand and gravel in the last nine years, which is largely coincident with the growth of the cement industry in the same period, cement production having increased from 25,274,949 bbls. in 1902 to 77,785,141 bbls. in 1910.

Sand and gravel produced in the United States, 1902-1910, in short tons.

Years.	Quantity.	Value.
1902	1,847,901	$†1,423,614
1903	2,110,660	†1,831,210
1904	10,679,728	†5,748,099
1905	23,204,967	11,223,645
1906	32,932,002	12,698,208
1907	41,851,918	14,492,069
1908	37,216,044	13,270,032
1909	59,656,551	18,336,990
1910	69,410,436	21,037,630

A copy of Mr. Burchard's report may be obtained by applying to the Director of the Geological Survey, Washington, D. C.

†Includes only a very small quantity of gravel.

MEETING OF THE CEMENT SECTION OF THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

DURING the recent annual meeting of the American Society of Mechanical Engineers, occurred the second professional session of cement engineers ever held in this country. It was conducted under the management of a committee appointed by The American Society of Mechanical Engineers, to investigate conditions affecting the cement industry in this country, and to render a report, or suggest means whereby unsolved problems might be brought before the society as a whole, or new developments in the cement industry brought to its attention, with the purpose of keeping the members fully informed as to the best of recent technical developments and to permit also of applying solutions of problems in other fields to similar problems in the cement field.

This session was held Wednesday afternoon, December 6. Six papers were presented, illustrated by lantern slides. These included "Electrical Power in Cement Plants," by F. H. Lewis, Birmingham, Ala., "Confirmation of the Advantages of Electricity in Cement Manufacture," by J. B. Porter, of Philadelphia.

Both of these papers were discussed by Mr. Pratt, Mr. Wiley, H. J. K. Freyn, H. Struckmann, H. S. Spackman and H. F. Dudley. Two papers on the prevention of accidents in cement plants were next presented as follows: "Protection of Laborers From Accidents and Injury to Health in Cement Plants," by Dr. Otto Schott of New York, and "Methods and Appliances for the Prevention of Accidents in Cement Plants," by J. G. Bergquist, of Buffington, Ind. A paper was then presented by H. Struckmann on "Depreciation and Obsolescence in Portland Cement Plants," which was discussed by H. S. Spackman and Mr. Higgins. A second paper was presented by Dr. Schott on "The Dust Problem in Portland Cement Plants," which offers various methods of solution of this very important problem. This was discussed at length by Mr. Mason, H. S. Spackman, J. G. Bergquist, J. B. Porter, W. B. Ruggles, and Mr. Brown. It is, of course, impossible to print the papers in full but we give below abstracts from some of these papers which will give some idea of the representative character and thoroughness of investigations made.

In his paper on "Electrical Power in Cement Plants," Frederick H. Lewis said that the chief advantages of individual motor drives is the flexibility secured in the operation of a plant. Machines may be run or may be idle without affecting in any way, the operation of other machines. The motor also gives an advantage on mill drives but here it is less marked than in the case of auxiliary power. For lighting purposes, electric power is essential. For auxiliary power it has such great advantages and such marked economy that here also it may be considered essential. To be able to place power in an installation which is efficient at any point, however distant from its source or however awkwardly situated with reference to this power, is an advantage to be secured in no other way. The disadvantages of electric power in Mr. Lewis' opinion were,

First: INITIAL COST. The cost of an electric plant complete as compared with a steam plant for the main power drives of a cement mill a few years ago was about as two to one. Turbines are now so much cheaper than engines and require so much less room and electric generators and motors are so much cheaper than formerly, that present comparative figures are about 1.5 to 1.0.

Second: OPERATING COST. In Mr. Lewis' opinion there is no doubt that a completely equipped electrical plant will use more coal per barrel of cement than a plant engine driven. In a plant producing 2,000 bbls. of cement per day, the coal consumption may be 10 per cent greater. As the plant grows larger and the losses from power transmission by engine drive increases, this difference in fuel cost will no doubt disappear. The advantages of electricity become greater as the size of the plant increases.

Third: LIMITED OVERLOAD CAPACITY. This objection is one particularly applicable to the drives for heavy machinery, and is of less importance as plants become larger and the power required for individual motors becomes less in proportion to the whole amount of power consumed.

Mr. Lewis' conclusion was that for a plant of 2,000 bbls. or less, the power drives for the raw and finishing mills with auxiliary electric power appears to be advantageous. For larger units the electric mill is better. This conclusion is based upon purely mechanical considerations. There is, of course, also the human element to be considered, an element which may neutralize great mechanical advantages, or surmount great mechanical disadvantages.

J. B. Porter in his paper entitled "The Confirmation of the Advantages of Electricity to the Cement Manufacturers," emphasized the great advantages in flexibility of the electrical over the mechanical drives. This applies both to the operation of the power plant and to the mill itself. The advantage of this flexibility in the operation of the various machines is something that cannot be stated in figures, but which is recognized by all cement men. The latitude which the use of individual motor drives gives in the operation of a mill is well illustrated in starting new plants. Parts of the apparatus can be put into operation long before the construction work is completed on the entire plant. Several months often elapse after starting the first kiln before the plant is in full operation. In the meantime with the motor drive the completed portions of the plant are operated under practically normal conditions so far as power per barrel is concerned. This point is not so important in itself after a plant

has started but it illustrates the case with which an electrically operated mill can be run at reduced capacity, a matter which the fluctuations of the cement market force the engineer to consider.

In conclusion Mr. Porter says that the advantages of electricity in the manufacture of cement are confirmed by the engineer. The last twenty plants constructed have installed the electric drive complete, except three, and these have used the mechanical drive only in two departments, and yet the kilns are driven with individual electric motors. It is considered imperative to equip a cement mill with more than one kiln in order to have the flexibility of independent units.

Dr. Otto Schott in his paper on "The Protection of Laborers From Accidents and Injury to Health in Cement Plants," gives a very complete and comprehensive description of the devices employed in German cement mills for the protection of laborers from injury, although in his opinion, appliances for the protection of the laborer has been given less attention in America than in Germany. The general conclusion drawn by his hearers after hearing the address and seeing views upon the screen, was that American manufacturers are not very far behind in this respect. With a few exceptions the devices shown by Dr. Schott are already in use in this country or satisfactory equivalents have been provided.

Mr. Bergquist presented a paper on "Methods and Appliances for Prevention of Accidents in Cement Plants." Mr. Bergquist's lantern slides illustrated appliances in use at Plant No. 6 of the Universal Portland Cement Co., at Buffington, Ind. This problem has been given much thought and study and in working out their system, they have had a great deal of advice and help from the steel mills and especially from the South Works of the Illinois Steel Co., and the bulletins issued by the General Safety Committee of the U. S. Steel Corporation. Mr. Bergquist said the cause of an accident in either unsafe conditions or carelessness on the part of the workmen, hence the remedy resolves itself into

First: The safe-guarding of dangerous places, so that any man exercising ordinary care is not required to take any risks in the performance of his duties, and

Second: To promote carefulness throughout the whole organization which requires systematic and persistent effort on the part of the management.

After illustrating by lantern slides a number of very complete devices for preventing injury to workmen from machines, electric currents, and explosions of coal dust, Mr. Bergquist described what the company was doing to promote carefulness among the men. "When a man comes to their employment office for work, if he is a skilled workman, we require his record for at least five years. He is then given one of our books of rules on safety and is required to sign a receipt for same, which receipt can be found on the last leaf of each book and which reads as follows: 'I have to-day received the book of rules issued by the Universal Portland Cement Co., which I shall carefully read and live up to.' Books are also issued for the superintendents and foremen. That for the workmen contains twenty-five pages and is printed in five different languages which includes those of all the various nationalities in the employment of the company who are not familiar with English. Constant vigilance is essential to keep the subject alive and to keep up the interest and co-operation of the foremen and the men under them. This is largely a question of advertising and to this end inspections and reports of conditions at the plant are made at regular intervals by a committee consisting of one operating, one mechanical and one electrical foreman. Foremen are required to know the rules of the book, they are questioned by the safety inspector, and in passing such examination, they receive a button. Also any workman can obtain one of these buttons by passing an examination, the aim being to make this emblem somewhat a mark of distinction.

During the years 1907 and 1908 the percentages of accidents to the number of men employed ran from 15 per cent to 16 per cent and at the present time it does not exceed 5 per cent, which proves very clearly that this work has not been wasted."

One of the most valuable papers was presented by H. Struckman on "Depreciation and Obsolesence in Portland Cement Plants." Mr. Struckman says that whereas elaborate systems are carried out in connection with the business end of the industry, it seems strange that so important an item of the cost accounting as the wear and tear of the machinery, as well as the obsolesence, should not be given more attention than it has been given in the past. To arrive at a fair percentage to be charged for depreciation, it is necessary to determine the probable life of the machinery and buildings. The argument is heard quite frequently that if a machine is maintained in a state of efficiency by repairs and renewal of parts, it does not depreciate as long as it does the work and that it is just as valuable when it is ten to twenty years old as when new. It is true that it could be kept alive indefinitely by renewing its parts, but we must believe that it will be sure to grow obsolete and that its value at any given time would depend upon the condition of its various parts at that time and because each part has a life, the elimination of the life of that part is going on each day. It is absolutely necessary to create a fund equal to the amount of the depreciation from year to year and to keep it intact for the purpose of replacing the machinery and buildings at the end of their life, and this provision should be made without any reference to profits or losses of trade, as depreciation for wear and tear and also obsolesence is a part of the working expense of a business.

Dr. Otto Schott presented a second paper on "The Dust Problem in Portland Cement Plants and its Solution."

Dust-eliminating devices used in European cement factories have, generally speaking, hygienic motives, inasmuch as the authorities demand the

use of contrivances that will protect the physical welfare of the workmen and keep the environs of the factory free from dust. The great progress made in this line, however, would hardly have been possible for this reason alone, had not the dust collecting devices been found to represent the means of great economy and money-making.

Two points to be considered are

First: Dust-eliminating contrivances for depositing or beating down the dust originated in grinding, packing and conveying the materials when the temperature of the dust-filled air is normal.

Second: Removal of the dust from the waste gases of the drying drums and kilns, a more difficult problem owing to the high temperature and to the acqueous vapors contained in the gases.

His paper gave an exhaustive description of appliances in use in Germany and other European countries. The waste gases of the kilns also contain beside the dust, another constituent which may be turned into money again. This is the heating value contained in the high temperature of the waste value contained in the high temperature of the waste gases. In order to demonstrate and prove what enormous quantities of cement may be gained by dust elimination, an example of practical experience was given. The plants of the works referred to are fitted with Bett's Sleeve Filters with which daily experiments were made. This factory has a daily production of 1,000 bbls. In one day of 23 hours 3800 kg. or 166 kg. per hour of cement was collected. As conditions are in Germany, the daily gain is approximately $28.50. In the raw mill, about 2,000 kg. are collected amounting to a value of about $6 hence the daily saving amounts to about $34.50 or $10,350 per year of 300 days. It cannot be regarded as an exaggeration that in the American cement factories many hundred thousands of dollars are wasted every year and that too at a time when the price of cement had fallen to a level leaving hardly any margin of profit to the manufacturers. Europe, twenty years ago faced the problem of eliminating dust from cement factories that is confronting America today, and which is imperative of solution not only for hygienic but for economical reasons. America has the great advantage of European experience to draw from and has many highly efficient dust eliminating devices, which have been tried and proved in European plants.

Altogether the meeting was most interesting and valuable, and the work of this section promises much for the coming year. Membership on this committee is not confined to members of the American Society of Mechanical Engineers; on the contrary, it includes men who are recognized as possessing special knowledge and experience in the cement industry, without regard to society membership. The committee at present consists of 16 men as follows:

Bergquist, J. G. (non-member); Cowhan, W. F. (non-member); Dunn, W. R. Chairman; Fuller, J. W. Jr.; Griffiths, Leonard L.; Hager, E. M.; Hunt, L. H.; Kelley, F. W.; Kind, Morris (non-member); Lewis, F. H.; Meade, Richard K. (non-member); Posselt, Ejnar (non-member); Seaman, H. J. (non-member); Struckmann, Holger; Tagge, A. C.; Wilson, P. H. (non-member).

Demolishing a Reinforced Concrete Grandstand

Cliff M. Stegner, Engineer, Department of Buildings, Cincinnati, is the author of an interesting article in *Engineering News*, Nov. 23, describing the razing of this structure. He states that the reinforced concrete grandstand of the Cincinnati Baseball Club was the first reinforced concrete construction of any consequence in that locality, and also the first reinforced concrete structure here to have outlived its usefulness. It was completed before the opening of the 1901 baseball season by the Ransome Concrete Co. in accordance with what was then known as the Ransome system.

The principal wrecking appliance was a derrick with a 50-ft. boom and a 3,000-lb. pile-driving hammer. The derrick was erected on the roof of the grandstand and moved from one end to the other as the wrecking progressed. In operating the derrick the hammer was raised to the top of the boom and permitted to fall about 50 ft. and crush the slab, the operation being repeated, wrecking first the roof and then the floor. After the debris had been cleared away, the columns were pulled over with a hoisting engine, which was readily accomplished after the farther vertical column bars had been cut by an oxygen-acetylene flame. All structural material was found to be in a fairly good state of preservation.

The destruction of the building afforded an excellent opportunity to make comparisons between present practice in concrete design and that of ten years ago.

The use of cold-twisted steel reinforcement, the concrete mix, and the tensile and compression stresses, were in close conformity with local practice at the present time. It was apparent, however, from the absence of bent tension rods and web reinforcement, together with the fact that the beams were narrow in comparison with their height, that the subject of shear was not thoroughly understood. The weakness in shear was well illustrated when the hammer was dropped sufficiently close to break, but not to crush a beam, when the failure was invariably in the web by horizontal shear or diagonal tension.

The structure contained two different 1.2.4 concretes, the aggregates being crushed limestone with dust, and washed river pebbles of trap or silicious nature. The former broke into small fragments with considerable dust, while in the latter the pieces were larger with little or no dust.

Molds for Cement

Under a patent granted recently molds made of paraffin wax or similar material, are produced by dipping a mold-former covered with a layer of moisture, into melted paraffin wax, then withdrawing it, and detaching the film of wax in the form of a mold. The walls of the mold may be laminated by coating the mold-former with successive layers of wax, which shrink one upon another. Concrete, cement, or the like, after mixing with water, is introduced into the wax molds, and when it has set, the wax mold is melted off by means of hot water.

GLORY-HOLE QUARRYING

The accompanying photograph shows the glory-hole at the quarry of the Superior Portland Cement Co., Concrete, Washington. This view but for delay in transit should have been included in the article on this subject by Paul C. Van Zandt, in the December issue. Mr. Van Zandt sends in the following notes to accompany the photograph:

A "GLORY HOLE" QUARRY FROM ABOVE. Compare this with Fig. 2, page 7, "Cement Age" for July, 1911, which is a photograph of a German quarry.

This glory hole is opened up close to the edge of the rock face, and is, therefore, practically open on one side. The wall at the right of the picture constitutes a dyke or dam, separating the glory hole from the face of the rock. The men in the quarry are standing directly over the upraise.

This photograph was furnished by the courtesy of Wm. H. Kewish, Gen'l Supt. of the Superior Portland Cement Co., who has called the writer's attention to the economy of quarrying by this method where a large crusher is used and located at the bottom of the upraise.

The cost of such items as track, cars, steam shovels, locomotives, and their maintenance and upkeeps are all eliminated. The rock brought down by a blast rolls all the way into the crusher.

It is also a simple thing to figure out the rock available in the glory hole, having an upraise of 300 feet high, all of which could be put through the crusher before it would be necessary to dig a new upraise and move the crusher. The angle at which crushed rock will flow into the glory hole is below 40 degrees.

Credit should have been given to Arthur T. Smith for the photographs in the December issue of the clay quarry of the Washington Portland Cement Co.

Cement Floor Tiling in Panama

Hydraulic tiling for flooring is imported into Colon, and the bulk of it comes from Italy and Spain, although small amounts are imported from time to time from Venezuela and Colombia.

During 1910 about 200 square meters (square meter=10.76 square feet) were imported from Italy and about 140 square meters from Spain. The Italian hydraulic tiling sells for 32 cents to $1.50 United States currency per square meter f. o. b. Genoa, while the Spanish article sells for 80 cents to $2.75 per square meter f. o. b. Barcelona—the prices varying according to the pressure used, design, and amount of marble employed. The cement and sand variety sells for 32 to 80 cents, while the Venetian style sells for 80 cents to $1.50 per square meter.

Tiling is packed in crates, the blocks standing on end with straw between, and each crate contains one square meter. Freight charges from port of shipment amount to about $5 per ton.

The laying of tiling is done by Italian and Spanish experts. First a layer of sand is spread on level earth, after which a layer of cement and sand is put on, upon which the blocks are closely laid, and then the whole surface is gone over with cement and water, which is afterwards swept off. The experts charge $1.50 for laying 1 square meter of tiling, they furnishing the material, such as cement, sand, etc. This is considered a high price and it is expected that non-experts will soon be induced to take up this kind of work.

The Italian and Spanish tiling is manufactured in the interior towns, whence it is transported to the seaports of Genoa and Barcelona for shipment to Colon. The Venezuelan tiling is manufactured in Caracas and the Colombian in Cartagena. About four years ago a Venezuelan started a factory for the manufacture of hydraulic tiling in the city of Panama and for a while did a very good business, but later on the demand fell off and the factory was shut down. Six months ago, however, a native company started a factory in Panama, turning out about 150 blocks of hydraulic tiling per day; this tiling is sold at $2.25 to $3 per square meter.

The sanitary regulations in Colon require that the space under the ground flooring of buildings be laid, to a great extent, in concrete, hence several property holders who are erecting new buildings are putting in tile floors instead of wood. Although the tile costs almost twice as much as the wood, it is more durable, more attractive, and more sanitary. At the present time there are about a dozen houses here that are provided with hydraulic tiling floors, and the demand is increasing.—*Trade and Consular Reports.*

REINFORCED CONCRETE REGULATIONS FOR GREATER NEW YORK

FOLLOWING are the uniform regulations which will cover reinforced concrete construction in the five boroughs of Greater New York. The work of drafting these regulations was directed by Rudolph P. Miller, superintendent of buildings for Manhattain, and the regulations were adopted Dec. 28 by the superintendents of all the boroughs. The regulations went into effect January 1, 1912. The clause on hooped columns is not as adequate nor as fair to such construction as probably the best judgment of the drafters would have made it, but the effort was made to follow the conservative opinions of the joint committee. These regulations are a detailed interpretation of the clauses in any code requirements covering concrete construction.

1. The term reinforced concrete in these regulations shall be understood to mean an approved concrete mixture reinforced by steel of any shape.

2. Reinforced concrete will be approved for all types of construction if the design is in accordance with good engineering practice and stresses are figured as required by these regulations.

3. Before permission to erect any reinforced concrete structure is granted, complete drawings and specifications must be filed with the superintendent of buildings, showing all details of the construction, the size and position of steel reinforcement, and the composition of the concrete.

4. The concrete for reinforced concrete structures shall consist of a wet mixture of 1 part of cement to not more than 6 parts of aggregate, fine and coarse, either in the proportion of 1 part of cement, 2 parts of sand and 4 parts of stone or gravel, or in such proportion that the resistance of the concrete to crushing shall not be less than 2,400 lbs. per square inch after hardening for 28 days.

5. Only Portland cement meeting the standard specifications for cement of the American Society for Testing Materials shall be used in reinforced concrete structures.

6. Fine aggregates shall consist of sand, crushed stone or gravel screenings, passing when dry a screen having ¼-in. diameter holes, and not more than 6 per cent passing a sieve having 100 meshes per lineal inch. It shall be clean and free from vegetable loam or other deleterious matter.

7. Mortars composed of 1 part Portland cement and 3 parts fine aggregate by weight when made into briquettes should show a tensile strength of at least 240 lbs. per square inch at 28 days.

8. Coarse aggregate shall consist of crushed stone or gravel which is retained on a screen having ¼-in. diameter holes and graded in size from small to large particles. The maximum size shall be such that all the aggregate will pass through a 1-in. diameter ring. The particles shall be clean, hard, durable, and free from all deleterious material.

9. Steel for reinforcement of concrete shall meet the requirements of the standard specifications for steel reinforcement of the American Railway Engineering and Maintenance of Way Association.

10. Wire used for column hoops shall be drawn from open hearth billets and shall have an ultimate tensile strength of not less than 85,000 lbs. per square inch.

11. The span length for beams and slabs shall be taken as the distance from center to center of supports, but need not be taken to exceed the clear span plus the depth of beam or slab. Brackets shall not be considered as reducing the clear span.

12. Length of columns shall be taken as the maximum unsupported length.

13. All reinforcement shall be accurately located and secured against displacement. The reinforcement for slabs shall not be spaced farther apart than 2½ times the thickness of the slab.

14. Slabs shall not be less than 4 in. in thickness for floor and 3½ in. for roofs.

15. As a basis for calculations for the strength of girders, beams and slabs the following assumptions shall be made.

- (a) A plane section before bending remains plane after bending.
- (b) The modulus of elasticity of concrete in compression remains constant within limits of working stresses fixed in these regulations.
- (c) The adhesion between concrete and reinforcement is perfect.
- (d) The ratio of the modulus of elasticity of steel to the modulus of elasticity of concrete is 15.
- (e) Concrete has no value in resistance to tension.
- (f) Initial stress in the reinforcement due to contraction or expansion in the concrete is negligible.

16. The bending moment of slabs uniformly loaded and simply supported shall be taken as ⅛ Wl, where W = total load and l = span.

17. The bending moments at the center and at intermediate supports of floor slabs continuous over two or more supports shall be taken as 1/12 Wl.

18. The bending moments of slabs that are reinforced in both directions and supported on four sides and fully reinforced over the supports (the reinforcement passing into the adjoining slabs) may be taken as 1/F Wl for loads in each direction, in which $F = 8$ when the slab under consideration is not continuous or when continuous over one support, and $F = 12$ at both center and supports when the slab is continuous over both supports. The distribution of the loads shall be determined by the formula.

$$r = \frac{l^4}{l^4 + b^4}$$

in which r equals proportion of load carried by the transverse reinforcement, l equals length and b equals breadth of slab.

19. Simply supported beams shall be considered as simple beams with bending moments of ⅛ Wl.

20. Beams supported at one end and continuous at the other shall be considered as partially restrained with a bending moment of 1/10 Wl at the center and ⅛ Wl over intermediate support.

21. Beams supporting rectangular slabs reinforced in both directions shall be assumed to take the proportions of load as determined by the formula in section 18.

22. The bending moments at center and support for beams or girders continuous over two or more supports shall be taken at 1/12 Wl.

23. The bending moments due to other than uniformly distributed loads shall be computed according to accepted theory.

24. Where adequate bond between slab and web of beam is provided, the slab may be considered as an integral part of the beam provided its

effective width shall not exceed on either side of the beam 1/6 of the span length of the beam nor be greater than six times the thickness of the slab on either side of the beam, the measurements being taken from edge of web.

25. Members of web reinforcement shall be so designed as to adequately take up all involved stresses throughout their entire length. They shall not be spaced to exceed three-fourths of the depth of the beam in that portion where the web stresses exceed the allowable value of concrete in shear. Web reinforcement, unless rigidly attached, shall be placed at right angles to the axis of the beam and carried around the extreme tension member.

26. Reinforced concrete structures shall be so designed that the stresses in the concrete and steel shall not exceed the following limits:

	Per sq. in.
Extreme fibre stress on concrete in compression	650 lbs.
Concrete in direct compression	500 lbs.
Shearing stress in concrete when all diagonal tension is resisted by steel	150 lbs.
Shearing stress in concrete when diagonal tension is not resisted by steel	40 lbs.
Bond stress between concrete and reinforcing bars	80 lbs.
Tensile stress in steel reinforcement	16,000 lbs.
Tensile stress in cold drawn steel wire used as column hooping	20,000 lbs.

In continuous beams the extreme fibre stress on concrete in compression may be increased 15 per cent adjacent to supports.

27. Axial compression in columns without hoops, bands or spirals, and with not less than ½ nor more than 4 per cent of vertical reinforcement secured against lateral displacement by steel ties placed not farther apart than 15 diameters of the rods nor more than 12 in., shall not exceed 500 lbs. per sq. in. on the concrete nor 6,000 lbs. per sq. in. on the vertical reinforcement.

28. Axial compression in columns with not less than 1 per cent of hoops or spirals spaced not farther apart than 1/6 of the diameter of enclosed column and in no case more than 3 in., and with not less than 1 nor more than 4 per cent of vertical reinforcement, shall not exceed 725 lbs. per sq. in. on the concrete within the hoops or spirals nor 8,700 lbs. per sq. in. on the vertical reinforcement.

29. Axial compression in structural steel columns thoroughly encased in concrete having a minimum thickness of 4 in. and reinforced with not less than 1 per cent of hoops or spirals spaced not more than 12 in. apart may be taken at 16,000 lbs. per sq. in. on the net section of the structural steel, no allowance being made for the concrete casing. The hoops or spirals of the concrete casing shall be placed not nearer than 1-in. from the structural steel or the outer surface of the concrete. The ratio of length to least radius of gyration of the structural steel section shall not exceed 120.

30. In reinforced concrete columns the compression on the concrete may be increased 20 per cent when the fine and coarse aggregates are carefullly selected and the proportion of cement to total aggregate is increased to 1 part of cement to not more than 4½ parts of aggregate, fine and coarse, either in proportion of 1 part of cement, 1½ parts of sand and 3 parts of stone or gravel, or in such proportion as will secure the maximum density.

31. The vertical steel bars in reinforced concrete columns shall bear squarely on steel plates or casting bedded on top of the footing.

32. Bending stresses due to eccentric loads shall be provided for by increasing the section of concrete or steel until the maximum stress shall not exceed the allowable working stress.

33. Whenever it is necessary to splice bars, the connections between them shall be of sufficient strength to carry the stress.

34. In columns, the splicing of longitudinals, having an area less than 1¼ sq. in., may be done by lapping, the lapped bars to be wired securely to each other. Longitudinals having areas in excess of 1¼ sq. in. shall be spliced by butting the bars squarely one over the other and tying the same securely together by some mechanical means that will not utilize the adhesive strength of the concrete. All such splices shall be made above floor levels but not more than 12 in. above the same.

35. In columns the ratio of length to least side or diameter shall not exceed fifteen, but in no case shall the least side or diameter be less than 12 in.

36. The concrete members of floor construction in which hollow tiles, concrete blocks or other fillers are used, in combination with reinforced concrete, shall be designed in accordance with these regulations, except that the slab portion cast on top of the fillers may have a minimum thickness of 2½ in. provided the fillers do not exceed 60 per cent of the construction.

37. Exterior and interior bearing and enclosure walls of reinforced concrete, supporting floor and roof loads shall be securely anchored at all floors, and of such thickness that the compressive stress shall not exceed 250 lbs. per sq. in. but in no case less than 8 in. The thickness shall not be less than 1/20 of the unsupported height. Steel reinforcement shall be placed near both faces of the wall, running both horizontally and vertically and weighing not less than ½-lb. per sq. ft. of wall.

38. Footings for walls and columns may be constructed of reinforced concrete provided the working stresses for concrete and steel are not exceeded and the steel is protected by at least 4 in. of concrete.

39. The steel reinforcement in columns and girders shall be protected by a minimum of 2 in. of concrete; in beams and walls by a minimum of 1½ in.; and in floor slabs by a minimum of 1 in. of concrete.

40. The contractor may be required to make load tests on any portion of a reinforced concrete structure within the reasonable time after erection. The tests shall be made under the direction of the superintendent of buildings, and shall show that the construction will sustain safely a load of twice the live load for which it was designed.

41. These regulations do not apply to any construction for which provision is otherwise made in the building code.

Concrete for Culverts and Short Span Bridges

The construction of the numerous culverts and short span bridges required is one of the very important parts of the improvement of country roads and at the same time one that in the past has been greatly neglected. At present, however, it is being taken up and carried out intelligently and systematically, and is yielding results quite as satisfactory as those attained in any other branch of highway improvement.

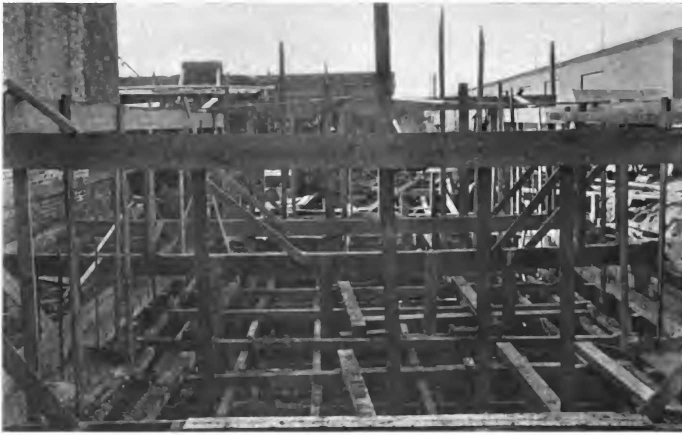


FIG. 1—THE INTERIOR OF THE PUMP PIT DURING CONSTRUCTION, SHOWING THE SUSPENDED CENTERING.

WATERPROOF PUMP-PIT CONSTRUCTION

A pump-pit has recently been completed at the warehouse of the New York Dock Co., Brooklyn, which involved interesting construction features. This pump-pit, approximately 25 ft. by 21 ft., and 7 ft. deep, contains the electrical pumps, valves and so forth, for the sprinkler system. Situated below tide water level, the pit is a monolithic concrete basin, with a continuous 12-in. wall and bottom.

In centering for this structure, no ties or bolts were used through the wall to hold the faces of the centering together. The outer face was braced to the sides of the excavation in the usual way. The entire interior system of centering was hung from a series of trusses. This is shown plainly in the accompanying photographs and sketch. Not only was it necessary to suspend the centering, but all the false work and bracing was also hung from the trusses.

There are approximately 50 cu. yds. of concrete

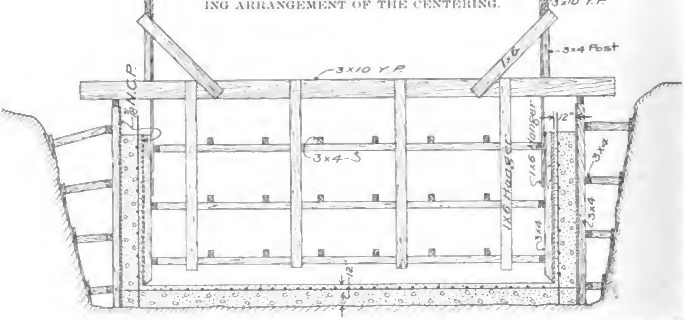


FIG. 2—CROSS SECTION SKETCH SHOWING ARRANGEMENT OF THE CENTERING.

in the walls and floor of this pit. It was run continuously. Havemeyer* bars were used, and the concrete was a 1.2.4 mix. Keystone† waterproofing compound was used in all the concrete.

J. W. Galbreath was consulting engineer for this work. We are indebted to W. A. Coriell, engineer of the Concrete Steel Co., for the notes and illustrations on this work.

Footbridge over River Sowe, Stafford, England

[*From Concrete and Constructorial Engineering, London.*]

The town council having recently laid out ornamental pleasure grounds on each side of the River Sowe, it was thought desirable to connect the two sections by means of a footbridge.

As the stretch of river passing through these grounds forms a pleasing feature from the Victoria Road, which is the principal approach from the railway station to the center of the town, it was important that care should be exercised in deciding upon a type of bridge which would be in keeping with and not detract from the beauty of the landscape.

It was also important that ample headroom should be provided under the center of the bridge to enable decorated boats used in the water carnivals held on the river to pass under. As the river banks are only 18 in. above water-level, this headroom could not readily be obtained with a bridge having a horizontal soffit.

Schemes for various types of bridges were prepared, including a bowstring-girder bridge and a suspension bridge. A reinforced concrete elliptical-arched bridge, with pierced parapets, was eventually decided upon.

The bridge, including the abutments, decking parapets and end piers, is constructed entirely of reinforced concrete; it has a clear span of 56 ft., and is 6 ft. between the parapets, which latter are 3 ft. 6 in. high. The distance from the surface of the soffit of the arch in the center is 6 ft. 2 in.

As the subsoil for a considerable depth consists of soft peat, each abutment is supported on four reinforced piles 14 in. square and 18 ft. long.

The bridge was designed to withstand a distributed load of 1 cwt. per foot super, and when the test load was applied the instruments showed a total deflection of 1/10 of an inch, which disappeared when the load was removed.

Notwithstanding the fact that all necessary ornamentation was eliminated on the score of expense, the general lines of the bridge are very pleasing.

South Guide Wall of Gatun Locks

The laying of concrete in the cellular portion of the upper guide wall at Gatun Locks was begun on September 30. The entire wall extends into the lake 1,500 ft. from the upper guard gates, and the south or outermost 850 ft. of it are founded on light earth, bed rock being about 150 ft. below the surface. On account of the character of this foundation the southern portion is being constructed upon piles, driven from 35 to 70 ft. into the ground, and to make the weight upon them as light as possible the wall is being made a reinforced concrete cellular structure.

It is estimated that 35,000 cu. yds. of concrete will be placed in the cellular part of the wall, and it is necessary to expedite the construction so that it may be completed to a height of 23 ft., elevation 55 ft., before April, 1912, when the surface of Gatun Lake will begin to rise, reaching 55 ft. above sea level about August, 1912. The chief obstacle to rapid progress is placing the forms, as 1,000 yds. of concrete a day could be supplied if a place were available to put it in place. Both the construction and auxiliary mixing plants will be used in supplying the concrete. A trestle 850 ft. long has been run from the west side of the locks alongside the site of the guide wall, and cars from the construction plant will deliver concrete on the west side of the wall to be placed by locomotive crane. On the east side concrete will be delivered from the auxiliary plant and placed by locomotive crane.—*Canal Record.*

*Concrete Steel Co., New York.
†Harrison Waterproof Materials Co., New York.

REINFORCED CONCRETE BRIDGE AT STAFFORD, ENGLAND.

STUDYING THE CONCRETE AGGREGATES OF WISCONSIN

A CAREFUL analytic study of concrete materials has been undertaken by the University of Wisconsin. In a recent issue of the *Wisconsin Engineer*, M. O. Withey*, in a most interesting paper, describes the purposes and methods of this "*material survey*." The purpose of the survey of sands, broken stones and gravels, was to determine their respective merits as aggregates for making mortar and concrete.

MATERIALS: Arrangements for securing material are made by a member of the laboratory force who, in general, inspects the deposit and determines the amount of the various aggregates needed for the tests. In order to make all tests outlined in the present schedule, about 3,000 lbs. of sand and 4,000 lbs. of broken stone, or the equivalent of other aggregates, is freighted into Madison in cement sacks. The effort is always made to secure a sample which will represent the average output of each pit or quarry. The material obtained is subjected to the following series of tests.

I. (a) Physical tests on aggregates.
1. Weight per cubic foot measured loose.
2. Percentage of voids.
3. Specific gravity.
4. Granulometric (sieve) analysis.
5. Percentage and character of silt.
6. Percentage of moisture.
7. Character or aggregates.

(b) Chemical tests (when necessary).

II. Physical tests on mortars made with a standard mixture of Portland cements and sands, screenings, of other material smaller than one-quarter inch in diameter.
1. Tensile tests on standard briquettes.
2. Compression tests on 3 x 6-in. cylinders.
3. Yield tests.
4. Absorption tests on 2, 2¼ x 4 x 8-in. specimens.
5. Freezing tests on specimens similar to those in 4.
6. Fire tests on specimens similar to those in 4.
7. Permeability tests on four cylinders 8 in. in diameter and 5 in. high.

(Tests Nos. 4, 5, and 6 are made at 60 days; No. 7 at 28 days.)

III. Physical tests on concrete made with a standard mixture of Portland cements and both fine and coarse aggregates.
1. Compressive strength of 6 x 18-in. cylinders.
2. Yield of concrete from each of the mixtures in 1.
3. Absorption tests on 2, 5 x 5 x 10-in. specimens.
4. Freezing tests on specimens similar to those in 3.
5. Fire tests on specimens similar to those in 3.
6. Permeability tests on 4 cylinders 16 in. in diameter and 9 in. high.

*Asst. Prof. of Mechanics, Univ. of Wisconsin.

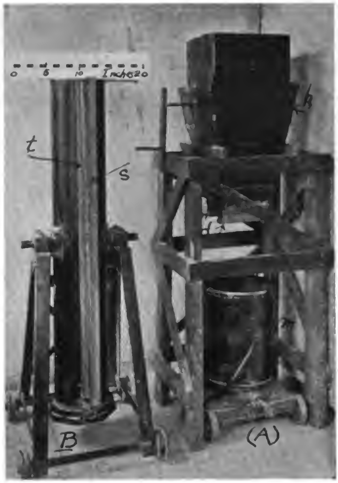


FIG. 1—(A) WEIGHT PER CUBIC FOOT APPARATUS; (B) VOIDMETER.

The general purpose of making physical tests is to ascertain what relations exist between these various physical properties and the physical properties of mortars and concretes made from the material under consideration. Some of these tests can be easily and quickly made, and afford valuable indications of certain properties which the corresponding mortar or concrete will possess. For instance, the weight per cubic foot, measured loose, is of importance in determining the percentage of voids, or space not occupied by solid aggregate. A knowledge of the percentage of voids is an aid in judging how much cement or mortar is required to fill up these spaces and produce a dense mixture. The weight per cubic foot is found by means of the apparatus shown in Fig. 1*A*. Sun-dried material is allowed to fall through the trap door, *d*, of the hopper, *h*, at such a rate that the cubic foot measure, *m*, is filled in one minute. The measure is then struck off even full with a straight edge and the material weighed.

THE PERCENTAGE OF VOIDS is found by pouring, very slowly, about three-fourths of a cubic foot of sun-dried material into the voidmeter, Fig. 1*B*, which contains about one-half cubic foot of water. Before and after the material enters the voidmeter, the height of the water column in the glass tube, *t*, is read on the scale, *s*, to .001 cu. ft. By correcting for the contained moisture in the sun-dried material, and the absorption after entrance into voidmeter, both percentage of voids and specific gravity can be computed.

THE GRANULOMETRIC ANALYSIS is made by screening a representative sample of sand, gravel or broken stone over sieves of different mesh and

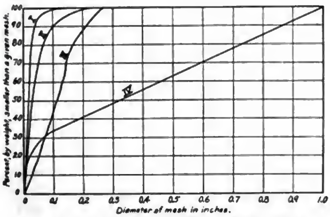


FIG. 2—CURVES SHOWING MECHANICAL ANALYSIS OF SAND.

determining the weight of material caught upon each sieve. By plotting a curve with percentage of sample (by weight) less than a given size of mesh as ordinates, and diameter of mesh as abscissae, the graduation of the material can be observed. Such curves may be seen in Fig. 2.

From elaborate experiments by Feret, Fuller, Thompson, and others, laws have been deduced from these mechanical analysis curves which are of considerable importance in estimating the value of aggregates. Consider curve I, Fig. 1; this represents a very fine sand which will make a mortar easy to work with a trowel, but which will be neither strong nor impermeable. The sand corresponding to curve II is well-graded and will make a very strong, dense, and impermeable mortar; but the mortar will not be so easily worked as that made from sand I. A very coarse sand is represented in curve III; this will make a strong, rough surfaced mortar which will be very difficult to work with a trowel. In still another way, have these gradation curves been employed. Experiments by Fuller and Thompson indicate that the densest, strongest, and most impermeable concrete is obtained if the gradation of all particles, including the cement, conforms to a definite curve formed by an ellipse and straight line tangent. Their curve for a mixture of gravel, sand, and cement, in which the diameter of the largest particle is less than one inch, is shown in curve IV. Similar curves to No. IV are used in this survey in determining the 1:6 and 1:9 proportions for concrete.

SILT is the name given to the very finely subdivided material of earthy or organic origin which is often present in aggregates, especially in sands and gravels. It has been found that certain kinds of impurities such as mica, loam, organic matter, or clay are undesirable elements in aggregates. Consequently, since these impurities are frequently in the silt, it is important to determine the amount and character of this finely subdivided material in order to estimate the value of an aggregate. In making the test, a 200 gram sample of the material is carefully weighed and placed in the percolator, *a*, shown in Fig. 3C. A piece of No. 200 wire cloth placed over the opening in the stopper prevents the fine material from descending into the pipe, *b*. Clean water is admitted from the aspirator bottle, *c*, and flows away from the percolator carrying the silt through the syphon, *d*, into the large can, *e*. At one minute intervals the material is thoroughly stirred. The process is discontinued when the water clears immediately after stirring, thereby showing an absence of silt in the percolator. The solution in can, *e*, is evaporated in a large evaporating dish and the residue scraped out, weighed, and preserved for chemical analysis. The percentage of silt and its character can then be determined.

CEMENT: In order that a minimum variation in the cement might obtain, it seemed advisable to mix different brands to form a standard Portland cement. The different brands are purchased in the open market and subjected to the standard tests.

PERMEABILITY TESTS: The specimens for permeability tests are molded with the end which is the bottom during the test uppermost. Neat cement mortar is placed in the bottom of the mold and around he casting, as shown in Fig. 4, to prevent water leaking through along the sides of the casting. Then mortar of wet consistency is put into the molds and tamped. The castings are filled with wet sand to keep the mortar from entering them. On the following day, the surfaces of specimens uppermost in the molds are cleaned with a stiff wire brush to remove the thin layer or nearly impervious matter, called laitance, which appears on the top surface during the process of setting.

Concrete specimens for the compression and permeability tests are made from machine mixed concrete. The required quantities of the different ma-

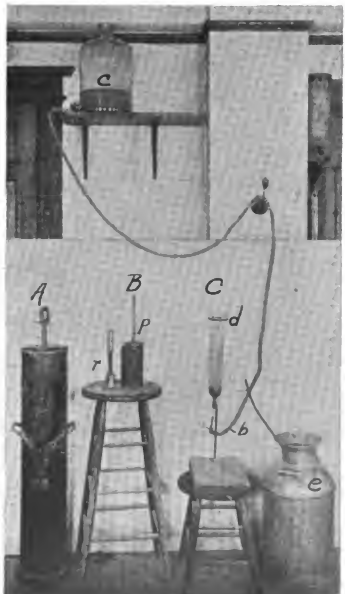


FIG. 3—(A) YIELD TEST APPARATUS FOR CONCRETE; (B) YIELD TEST APPARATUS FOR MORTAR; (C) APPARATUS FOR DETERMINING SILT.

terials are placed in turn in a hopper car and weighed on a triple-beam scales. All materials are mixed dry in a No. 0 Smith mixer for ¾ min., and wet for 2¼ min. A wet mix is employed for all specimens.

The concrete permeability specimens are molded, cured, and tested like the mortar permeability specimens. For the fire, freezing and absorption tests on concrete, specimens resembling small blocks are molded from the hand mixed concrete used in the yield tests. The dimensions of these specimens are made 5 x 5 x 10 in., so that they are comparable to small blocks sometimes employed in construction. They are removed from the molds after one day and then cured and tested like the mortar brick specimens.

THE YIELD TEST is used primarily to determine the volume of concrete or mortar which will be obtained if a given proportion of cement to aggregate is used. It is also possible to determine the density of the mix, and the relation between maximum density and ratio of volume of cement or mortar to voids in aggregate. Since the strength and impermeability vary with the density, this test is of importance. The yield test on a mortar is made by mixing a sufficient quantity of mortar of medium wet consistency to nearly fill the small cylinder shown at *B*, Fig. 3. The material is tamped into the cylinder in four layers by the rammer, *r*. The piston, *p*, with rod graduated to read to .0001 of a cu. ft. is lowered into the cylinder and whirled about to level the surface of the mortar. The spider, supported on the top of the cylinder and through which the piston rod slides, carries a mark from which readings are taken of the volume of the material in the cylinder. The weight of the materials before mixing, the weight of the cylinder, and the weight of the cylinder and mix are all taken. Consequently, if the weight per cu. ft. and the specific gravity of the different materials is known, the yield, or ratio of volume of mortar to volume of aggregates, and the density, or ratio of absolute volumes of cement and aggregate of total volume of mortar, can be computed. The yield test on concrete is made in a similar way by making use of the large cylinder, Fig. 3*A*.

ABSORPTION: Two of the bricks, or block specimens, from each mix are subjected to an absorption test. After drying to constant weight at a temperature above 250° F., the specimens are put into pans containing water two inches deep. They are surface dried and weighed at the end of 30 min., 4 hrs. and 48 hrs. From these data the percentage and rate of absorption can be determined.

FREEZING TEST: The same specimens employed in the absorption test are used in the freezing test. If the bricks have dried out they are again soaked in water four hours and then placed in a refrigerator in which the temperature is kept below + 15° F. After twelve hours or more in the refrigerator they are removed and plunged immediately into a tank of water in which the temperature is maintained above 150° F. Then they are soaked in hot water for one hour and put back again into the refrigerator. This cycle of operations is carried out ten times. Following the last soaking in hot water the specimens are weighed, allowed to dry out, and are then tested in cross-bending.

FIRE TEST: Two of the bricks, or block specimens, from each mix are subjected to a fire test. The specimens are placed in a cold gas-furnace, gradually heated to 1700° F., and then kept at this temperature for at least 30 min. Temperatures are measured by four thermo-couples placed in different parts of the furnace. Upon removal

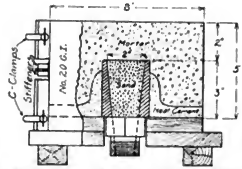


FIG. 4—METHODS OF CASTING PERMEABILITY SPECIMENS.

from the furnace, one specimen of each kind is immediately plunged into cold water and the other allowed to cool in the open air. Both are subsequently tested in cross-bending, and the results noted. The remainder of the brick and block specimens are tested in cross bending. Thus a relation between the normal strength and the strength of the brick after being subjected to the freezing or fire test is obtained.

RECORDS: Careful records are kept of all data taken, or connected with any of the tests, on blanks specially prepared for the purpose. To insure that the tests or changes in curing conditions will be made at the proper time, cards are made out as soon as the specimens are made and filed in chronological order. An assistant makes it his first duty each day to look at this card index and follow the instructions given therein. The results of the tests are filed in an index and the major portion of the data is computed as soon as it is determined, in order that errors in the method of making the tests or discrepancies in results may be observed and corrected before other tests are made. Whenever an amount of data has been compiled sufficient to warrant publication, a bulletin will be issued.

It is hoped that two things may be accomplished by this survey of aggregates, first, that more complete knowledge of the properties of the larger sources supplying such material may be obtained and published, thus benefiting the people of the state directly; and second, that the results obtained may be of value in advancing general knowledge concerning the properties of mortar and concrete.

Washing Gravel

[*From Engineering Record.*]

A gravel-washing apparatus for supplying concrete aggregate from suitable excavated material was constructed by a small addition to the mixing plant on one of the bridges of the Cleveland Short Line Railway. Two inclined timber tables were set beside the storage bin, one above the other, and dipping in opposite directions, so that material would run from the first onto the second and thence to a pit under the bin. A grating was placed at the foot of the first incline to prevent large stones or other matter from falling to the lower one. In the operation of the plant the excavating clam-shell bucket dumped on the top incline or table where a hose played on the material and washed it down to the second. Large pieces were screened out in passing, while fine sediment and light foreign matter were taken up by the water and carried off to one side. The clean gravel and sand collected in a pit at the foot of the inclines. A bucket elevator lifted the washed material to a revolving screen above the bins.

MUSHROOM VS. BEAM AND GIRDER ESTIMATE

LOCKWOOD, GREENE & CO., Boston and Chicago, architects and engineers for industrial plants, recently made comparative estimates of the cost of a building using the mushroom system of concrete construction and the beam and girder type. The unit prices used were from the latest records of work done in the vicinity in question and are as near correct as it is possible to obtain for a preliminary estimate. The figures do not represent average conditions. The estimate is made for a "strip," which is 19 ft. 3 in. wide, and the height of the building. The building is 580 ft. by 109 ft. in plan, 10 stories high.

The cubic yard price on 1:2:4 concrete is obtained as follows:

Cement 1 2/3 at $1.10 net	$1.80
Sand ½-yard	.40
Stone 1 yard	1.00
Labor	1.00
Sundries	.10
	$4.30 yds.

Columns cost 70 cts. per yd. more for labor.

One and one half and 3 concrete cost $1 more per yard for cement, making cost $5 per yard, for columns. The above item for labor includes transporting the stone and sand, and cement, from the storage house by the railroad to the two mixing plants, mixing and handling the concrete.

It should be noted that plant and tools are not included in these estimates nor any other items which would be common in both systems. Therefore these figures can in no sense be taken as an estimate of the cost of the building.

"MUSHROOM," ESTIMATES.

Concrete 1:2:4 interior cols.	$ 485
Concrete 1:1½:3 wall cols.	204
Concrete in floors, including slab capitals and wall beams	2,902
Forms for columns	720
Forms for column heads interior	120
Forms for wall heads interior	40
Forms for floor including slab and wall beams	1,748
Steel reinforcem't (cost inc. placing)	1,734
Steel lattice columns	3,016
Erecting lattice columns	160
Brickwork	198
Windows	897
Royalty	208
	$12,432

BEAM AND GIRDER ESTIMATE.

Concrete 1:2:4 interior cols.	$ 375
Concrete 1:1½:3 wall cols.	195
Concrete in floors (inc. beams, girders and slabs)	2,365
Forms for columns	756
Forms for floors, inc. beams, girders and slabs	2,754
Haunches	80
Steel reinforcing (cost inc. placing)	2,331
Bethlehem steel cols.	2,430
Erecting	160
Windows	810
Brickwork	360
	$12,616

From the above it will be seen that according to the figures of Lockwood, Greene & Co., in this case the total cost per strip for the beam and girder system is $12,616 while for the mushroom design it is $12,432 leaving a net saving of $184 per strip or $5,520 for the entire building.

Effects of Freezing on Concrete

MR. H. BURCHARTZ has made experiments to determine the effect of frost, if any, on the subsequent hardening properties of cement, mortar, and concrete, these having been previously mixed ready for use:—

Cement.—Tests were made on two samples of cement, which had been prepared in the dry and wet ways respectively. The cements were mixed with water to a stiff paste, and the time taken for hardening to begin and for complete setting under the conditions stated below:—

(1) The cements were allowed to set under normal conditions.

(2) The cements were kept as nearly as possible at a temperature of 0° C. equals 32° F.

(3) The cements were subjected to a temperature of — 10° C. for three hours.

(4) The cements were subjected to a temperature of — 10° C. for twenty-four hours.

(5) The cements were subjected to a temperature of — 10° C. for seventy-two hours.

These frozen samples, viz. (3), (4), and (5), were, at the expiration of the hours stated, broken up with a hammer, and, after being allowed to thaw, were stirred for three minutes. The times for hardening and setting were measured from this point forward. It was found that preliminary freezing did not affect the times of hardening and setting. The samples kept at 0° C., however, were about four times as long as the others in reaching each stage. During the tests the temperature and humidity of the air were carefully noted. The same cements were used to make mortar and concrete.

Mortar and Concrete.—The mortar consisted of 1 part by *weight* of cement to 3 parts by weight of standard sand. The concrete was made up of 1 part of cement to 5 parts of gravel. Two classes of each were prepared, sufficient water being added to make the mixture in the one class (1) "earth damp," and in the other (2) "wet."

Test pieces were made (1) immediately after mixing, and (2) after subjecting to a temperature of about — 14° C. (equal to 6.8° F.) for (a) three hours, (b) twenty-four hours, (c) seventy-two hours, and subsequently thawing. The test pieces were allowed to set under damp sand, some for seven days, and the remainder for twenty-eight days, and then tensile and compression tests were made.

The results showed that cooling for a few hours only had a negligible effect on the hardening of mortar and concrete, but that the rate of hardening was much lower after a prolonged freezing, this being strikingly accentuated for the "earth damp" over that for the "wet" mixings.—London *Builder*.

POLE PEDESTALS FOR CROSSING RESERVOIR

By W. J. Capen*

ON account of the City of New York increasing the size of the Kensico Reservoir, near Valhalla, Westchester county, New York, and flooding the ground where one of the Postal Telegraph Company's lines stood, it was necessary for the line to be moved.

Rather than lay a long stretch of submarine cable, or set three additional miles of poles in order to get around the reservoir, it was decided to carry the wires overhead across the reservoir at its narrowest point, by the use of steel lattice work poles set on concrete bases, the tops of the bases to be 5 ft. above the high water line. The ground being uneven, bases of different heights had to be built. Poles of various heights also had to be used for grading where the bank rose abruptly from the water line.

*General superintendent of plant, The Postal Telegraph Co., New York.

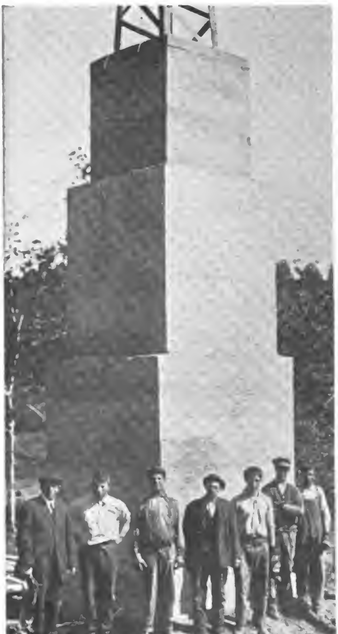


FIG. 2—DETAIL VIEW OF STEPPED-UP PEDESTAL.

FIG. 1—GENERAL VIEW OF POLE MOUNTED ON CONCRETE PEDESTAL.

The water was crossed at one point with five of the above mentioned poles and bases. The first base was made by excavating a hole 7 ft. square to a depth of 6 ft. Into this concrete was filled to a depth of two feet. The remainder of the base was then molded on top of this, that is, a portion 6 ft. square by 4 ft. high and another portion 4½ ft. square by 5 ft. high, making a total height of 11 ft.; 6 ft. being below and 5 ft. above ground. The earth which had been thrown out of hole was then filled in around base. Holes to receive the corner angle irons of pole which extended 6 ft. below lattice work, were molded in the base and after pole was placed in position these were filled up with concrete. A pole 30 ft. long was used. The other bases were made in the same manner, the dimensions varying somewhat as follows:

Second and third pedestal—
First section, 7 ft. x 7 ft. x 2 ft.
Second section, 6 ft. x 6 ft. by 9 ft.
Third section, 4 ft. x 6 in. x 4 ft., 6 in. x 5 ft.
30-ft. poles were also used here.

Fourth pedestal—
First section, 9 ft. x 9 ft. x 2 ft.
Second section, 7 ft. x 7 ft. x 15.
Third section, 6 ft. x 6 ft. x 7 ft.
Fourth section, 4 ft. x 6 in. x 4 ft., 6 in. x 5 ft.

A 35-ft. pole was set on this base, corner irons having an extension of 7 ft.

Fifth pedestal—
First section, 9 ft. x 9 ft. x 2 ft.
Second section, 7 ft. x 7 ft. x 4 ft.
Third section, 5 ft. 6 in. x 5 ft. 6 in. x 5 ft.

A 50-ft. pole was set on this base; corner irons having an extension of 7 ft. The poles are from 330 to 650 ft. apart.

Another portion of the reservoir was crossed by the use of two poles 30 ft. in length and 425 ft. apart, set on bases 10 ft. above ground. When excavating for these bases rock was encountered about 3 feet below the surface. Holes were drilled in the rock anchors inserted, the upper parts of which were imbedded in the concrete.

IMPORTANT ENGINEERING WORK IN SILESIA

Concerning engineering work abroad, mention might be made of recent developments in Silesia involving the use of an immense quantity of cement.

From time immemorial the valleys of Western Silesia and the adjacent regions have been periodically devastated by floods, but until recent years the measures taken to moderate their destructiveness had little practical effect. The situation was aggravated by the fact that nearly all took place in the summer about harvest time and therefore did far more damage than the less abrupt floods of early spring.

The damage is done by the river Oder and tributaries on the left, the district to the right being comparatively unimportant. It was proposed, some of the work being finished, to resort to river training, which would also involve the construction of dams and reservoirs.

The general system consists of a series of comparatively small reservoirs placed above the principal towns and villages on the head-streams—these would have only a local effect—and lower down at a suitable site on the main stream a reservoir of large capacity which would act favorably on the whole valley below.

As an indication of the magnitude and importance of the work it may be stated that near the head of the Queis there is a reservoir of 750 million gallons for the protection of the town of Friedeberg, and lower down, above Marklissa, another holding 3,300 million gallons. Situated on the other principal left-bank tributaries of the Oder in Silesia there are five reservoirs ranging from 500 to 110 million gallons in capacity. With the exception of those at Mauer and Marklissa all these will have only a more or less local protective effect; they are normally empty, only coming into use in times of flood, but the Mauer and Marklissa reservoirs are large enough not only to prevent floods below them, but also to permit of the lower portions being utilized to store water for creating electrical energy at the power stations below the dams.

The biggest work is the construction of the Mauer dam at a gorge where the Bober drains an area of 300,000 acres. The work is approaching completion, and will be brought into use next year. As above stated, the capacity of the reservoir thus formed will be 11,000 million gallons, of which 4,400 million gallons will be used for power purposes, the upper portions being normally empty to receive floods.

The total amount of masonry work will be 327,000 cu. yds., and the mortar employed consists of one part of cement, half-part of trass, one-third part of lime, and five parts of sand.

The other big piece of construction is the Marklissa dam on the Queis. The reservoir contains 3,300 million gallons when full, of which 1,100 million gallons are stored for power purposes. The drainage area is 75,600 acres. At the dam the depth when full is 123 ft., but the normal depth is about 90 ft.

In addition to the construction of dams an extensive training of the river channels has been taken in hand.

Here the flood evil has been remedied by forming cascades and low weirs, which hold up the boulders and break the velocity of the current, together with a careful strengthening of the river banks. In the lower reaches the work consisted chiefly in equalizing the cross-section to pass as far as possible a predetermined discharge and in strengthening the river banks. Wherever possible, the latter were treated simply by turfing with fascine work, seldom with pitching, at the foot. Where space for a flat slope was not available retaining walls were constructed, and if the banks consisted chiefly of alluvial beds of a more or less sandy nature, extensive use was made of palisading. Where required, the clear-way under bridges was increased, and this sometimes rendered a reconstruction necessary. In places the river channel was entirely changed.

Who Invented Portland Cement?

We observe with regret the announcement of the death of Isaac C. Johnson, of Gravesend. When Mr. Johnson, who died on Thursday last, celebrated his 100th birthday last January, the king sent him a congratulatory message. In the announcement of his death, and in earlier references to his remarkable career, it has been repeatedly claimed for him (although we are not aware that he ever advanced the claim himself) that he was "the inventor of Portland cement." This statement, while it might possibly be defended on the ground that Mr. Johnson was a pioneer in the industry, and among the first to effect improvements which put the product upon a commercial basis, seems to ignore the fact that the actual "discovery" of the material is credibly attributed to one Aspden or Aspdin.* But, at all events, seeing how universal and, it may almost be said, how indispensable, is the use of Portland cement today, it is little short of astonishing to reflect that the invention of the material, substantially as we know it (for of course some sorts of natural cement were of prehistoric origin), could be attributed without anachronism to a man who only last week was living among us. But even more astonishing are the improvements in the manufacture, which within the past decade or so have produced a material that, thanks as much to chemical reseach as to mechanical ingenuity, is well-nigh perfect.—*Architects and Builders Journal* of London.

*Compare "Cement Age" for December, 1911, page 254.

REINFORCING STEEL IN THE CLEVELAND BUILDING CODE

A decision of far-reaching import to the users of reinforcing steel is embodied in the recent revision to the Cleveland Building Code. In the fall of 1908, the clauses covering reinforcing steel were so worded as to allow re-rolled material to be used. The matter was again brought up during the past summer, and the re-rolling interests, not content with a code which simply allowed the use of re-rolled material, submitted their reasons for a specific recognition of their material.

An interesting angle in the consequent contest was that the debate centered around the quality of steel originally going into the rails, and the fact that rail steel is closely inspected and rigidly tested had much to do with the outcome.

The revision is important in that it is the first to recognize re-rolled steel as such, and that under proper conditions of manufacture, established by adequate test, its use is not only permissable, but entirely openly and specifically provided for. The clauses now governing this point are as follows:

AMENDMENT TO SECTION 466: All reinforcing steel shall be tested by an approved testing laboratory, and the department of buildings may, at any time, demand that certified copies of all test records be submitted to it for examination. All steel used for reinforcing purposes shall comply with the "Standard Specifications" governing the chemical and physical properties of concrete reinforcing bars as adopted by the Association of American Steel Manufacturers, 1910.

The above modified—

All reinforcing steel not rolled from billets, shall be rolled from standard section Tee rails, and shall comply with the physical tests specified in paragraph 2 of the above mentioned Standard Specifications. A complete physical test shall be made, by an approved testing laboratory, of each size of bar to be supplied by the manufacturer of the contract from each ten-ton lot or less.

These tests and materials shall be subject to the regulations prescribed in paragraphs 2, 4, 5a, 6d, 7, 7e, 7f, 9, 10 of the above mentioned specifications.

Hot twisted bars, of high carbon steel, shall be twisted with one complete twist in a length equal to not more than twelve times the thickness of the bar.

The department of buildings may demand the owner, builder, contractor, sub-contractor or foreman to make, or cause to be made, bending tests in the field on all grades of reinforcing steel, when in their opinion there is any doubt as to whether the reinforcing steel is up to the standard of these regulations.

These bending tests shall be those specified in the above mentioned "Standard Specifications."

Grear Water Power Sites

Under this title Henry Hale describes in *Cassier's Magazine* for September the tremendous importance of modern water power development with special reference to the great plants already established. In all these undertakings concrete has been a factor of extreme importance, a conspicuous example the famous McVall Ferry plant on the Susquehanna. In the construction of the station for this plant an erecting bridge was required, as no false work of wood would resist the river in flood. The bridge which was removed after the completion of the work was 2,000 ft. long, with arches of 40-ft. span and with a roadway 50 ft. wide, carrying four railroad tracks. The article is illustrated with photographs of notable works.

The Austin Dam Failure

Following is the official report of Alex. Rice McKim, State Inspector of Dams and Docks, for the New York Conservation Commission:

On October 11 last, I inspected the remains of the dam at Austin, Pa., owned by the Bayless Pulp & Paper Co., at Binghamton, N. Y. This dam was built of concrete in which large stones were embedded. It was 40 ft. high, 544 ft. long, 2½ ft. wide on top, and supposed to be 30 ft. wide at base. It was completed December 1, 1909, and filled January 21, 1910. Two days later a section slid out some 18 in. at the base, and water in large quantities came through the ground below the dam. The reservoir was then emptied, a short section at the top 2 ft. deep having been blown out by dynamite in an attempt to hasten its discharge. A month afterward without any strengthening whatsoever, the dam was refilled up to the breach made by the dynamite. At this time there was a leakage under the dam of 600 gallons per minute. And on September 30 last, the dam gave way completely.

The failure was principally due to the dam not being properly bonded to the foundation rock bed beneath, and so it slid forward under the pressure of the water impounded, aided by water leakage under the dam.

The engineer's plans, as published, show the concrete of the dam running down into a channel cut from the rock foundation bed, 4 ft. deep and 4 ft. wide, for the entire length of the dam. But on the up-turned section of the dam now lying in the river, I could see no evidence of any such wall having been built into the rock at all. As far as I could see from this section, and from the east remaining section, which has moved but little, the dam was simply placed on top of the rock bed and not let into it anywhere.

The only anchor was 1¼-in. rods every 2 ft. 9 in. along the up-stream face. And these were absolutely of no use, because when they had been stretched so as to act, the whole dam was in motion, when nothing could have stopped it. Dams should be built heavy enough to resist all possible opposing forces without depending upon steel reinforcements which cannot be brought into action until the masonry has failed.

Other defects were as follows:

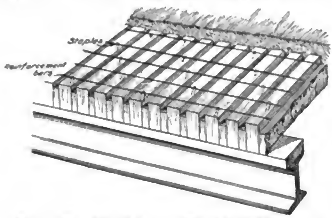
The seams in the rock bed above the dam were not all cleaned out and grouted, thus leaving easy access to water under the dam. The dam was built much too light, that is, not thick enough: the top thickness was but 2½ ft., and it should have been at least 4 ft., and 5 ft. would have been better: and the bottom width, shown on the published plans as 30 ft. measures on the east remaining section mentioned above only 20 ft. The spillway was rather small, being but 4 ft. by 50 ft. for a drainage area of 25 square miles. Many of the rocks imbedded in the concrete in the dam were of soft sandstone, slate, talc and other laminated rocks easily sheared in one direction, and laid so as to offer little resistance to horizontal shearing: one large section was broken off, splitting the rocks.

TAR CONCRETE WEARING SURFACES

CONCRETE is an ideal paving material, and much interest has been directed toward experiments which used a tar-sand coating or wearing surface for the heavy concrete base. Of interest in bringing more experience to this problem is the work done by J. G. McMillan, county surveyor of Santa Clara county, California. He has used for over 12 years, a solid timber floor, about as shown in the accompanying sketch, and covered with a concrete cushion surfaced with tar-concrete. The floor is described by an extract from recent specifications as follows:

The floor shall be built of main timbers 2 in x 12-in. and intermediate timbers 2 in. x 10 in. O. P. The outside timbers shall be 4 in. x 12 in. No intermediate splices shall be allowed. Each timber shall be spiked to the other successively with 50d wire spikes, the spikes to be spaced 18 in. apart.

After the timbers have been thoroughly spiked together, the entire top surface shall be covered



SKETCH SHOWING ARRANGEMENT OF McMILLAN'S FLOOR.

with a heavy coat of grade D asphalt, applied hot, and abutting ends shall be closely filled with asphalt.

There shall be ¼-in. round steel bars laid transversely on top of the floor timbers, 6 in. apart, then fastened with wire staples similar to those used for wire fencing, at least every 12 in. apart and staggered.

On the completion of the woodwork, and reinforcement, the surface shall be covered with Portland cement concrete, comprising one barrel of Portland cement to each 18 cu. ft. of sand and gravel. 3 in. deep above top of timbers.

The gravel shall contain no pebbles greater than one inch in diameter.

ROADWAY SURFACE: Just after the concrete has set there shall be spread over the roadway, a coat of refined asphalt, soft grade asphalt applied at not less than 300° F. and about one barrel to each 600 sq. ft., there shall then be spread over this hot screened sand; then rolled with a hot roller, more sand added, and the rolling continued till all the asphalt is absorbed by the sand.

A letter from Mr. McMillan to CEMENT AGE, December 13, 1911, is of interest, and in part, as follows:

I have been using this system of flooring with concrete surface with perfect success. I laid a floor on one of the main highways about three years ago with a concrete surface and up to the present time it has shown no visible marks of wear.

*From my experience I am beginning to have more faith in concrete for a wearing surface than I have in asphalt concrete or sheet asphalt of bitumen sand.**

If you are careful to finish the surface evenly but not slick smooth, and then after letting it set about 24 or 48 hours, apply refined asphalt (70° penetration) at 300° F. and hot sand, and a hot asphaltic hand roller, a layer about ⅛-in. to ¼-in. thick is built. This layer will protect the concrete for a number of years. Anytime that this surface shows wear it can be replaced at a trifling expense.

I have constructed a number of bridge floors without painting or asipitic treatment.

One that was built about six months ago, has had a recent severe test. The material for five miles of macadam road was carried in wagons, containing two yards to each wagon. The tires on the wagon wheels were not more than 3 in. wide. After close examination I fail to find any injurious effect upon this floor.

The italicized statement above is important, in definitely bringing many years experience in road surfacing to apply to our present day problems. Reinforced concrete is considered a better material for bridge floors than wood, and by its use, a surface could have been applied directly to the concrete siab. Mr. McMillan's work is of interest and value in furnishing some long time data on tarred concrete wearing surfaces.

Vibration in Buildings

The following paragraphs appear in a communication from Maurice Deütsch to *Engineering Record*:

The subject of vibration has of late been absorbing the attention of not only scientists but of the general public in large cities. Since the introduction of sky-scrapers, towering far above adjoining buildings, of large printing plants and power houses in large cities, various complaints of vibrations are frequently heard of. Subway trains now penetrating rock and then the softest quick-sands and the operation of heavy bed presses and reciprocating engines leave in their path a tremor to which many adjoining buildings are so naturally attuned that the vibrations are often not only annoying but dangerous, both to the building in which the machinery may be operating as well as to adjoining structures. One sometimes finds special localities to which vibrations are carried strongly while places nearer to the source may be relatively free from trouble.

In concrete-steel monolithic construction for mills and other structures, when properly designed, the entire mass acts as a unit to absorb vibrations set up in its various parts, the only tendency being to set up an oscillation of the entire structure, but this can be generally avoided if proper foundations are constructed. The 8-story reinforced concrete Ketterlinus building in Philadelphia is an excellent type of the most improved construction for large printing plants. Though the 15 and 20 ton presses are located on the third, fourth and fifth floors, very little vibration is noticeable.

*The Italics are ours.—Editors.

GOOD ROADS

THE Fifth Annual Report of the Board of County Road Commissioners, Wayne County, Michigan, is an inspiration for the advocate of good roads. For the believer in *concrete* roads, and these latter are probably to a great extent identical with the former, the pamphlet is a most valuable exposition of what can be done with this material.

The report is comparatively brief, considering what might be said on the subject, but it is decidedly to the point, to quote:

"We are pleased to report that our decision to adopt the concrete road as a standard of construction for Wayne County has been amply justified by the results. Woodward and Grand River Roads, built of concrete, and now in their third year, are wearing remarkably well; in fact our concrete construction has cost practically nothing for maintenance. We find further justification for our policy in the wear and tear of the macadam type of road

FIG. 1 (a). BUILDING A CONCRETE CULVERT; (b) STEAM TRACTOR HANDLING A TRAIN OF CONCRETE MATERIAL.

previously built by us The main roads on which macadam construction was adopted when we began road building in this county, have practically needed re-surfacing this summer at considerable expense.

"We have devised several improvements in our methods of construction, and in our specifications, which we believe will add materially to the life of our concrete roadways, and to the enjoyment of those who use them. Among the more important changes have been:

(1) The increase in the amount of cement used in our mix, changing from a 1.2.4 mix to a 1.1½.3 mix;

FIG. 2—A COUNTRY ROAD BEFORE AND AFTER THE "CONCRETE TREATMENT."

(2) A more stringent specification as to quality of stone and sand, especially with relation to its freedom from clay, loam and other foreign substances;

(3) An increase in the depth of the work from 6 and 6½ in. to not less than 7 in.;

(4) A protecting plate at the expansion joint.

"Our whole aim has been to provide the people of Wayne County with a *durable, permanent road at cost.* We believe the concrete road as devised and built by us has accomplished this purpose and that it is the coming roadway. It is low in ultimate cost, pleasing to the eye, smooth, dustless, and affords excellent traction for all types of vehicles."

The different stages of concrete road making are shown by series of detailed photographs. One photograph shows a small culvert under construction. The explanatory caption merits quotation:

"Building a reinforced concrete culvert. Practically a permanent structure. Wood and other materials susceptible to decay or deterioration are strictly tabooed. This culvert is built for present and future traffic needs and takes the place of the usual tumble-down wooden structure found on most roads when taken over by the county. Costs nothing to maintain. No re-planking, no painting, and no jolts and jars where it joins the roadway."

Materials are handled by thoroughly modern methods. Under the photograph showing a steam tractor hauling 3 wagon loads of stone, the explanatory note is:

"After the grade is prepared the material is

hauled on the road largely by our steam road engines. Each wagon shown above contains seven tons of material and on an average length haul will make as many trips per day as a good team. This outfit, aside from interest on investment, depreciation and repairs cost $9.50 a day to operate which includes wages of engineer and fireman, as opposed to $5 a day for a team. Two tons per trip is a good load for a team over an ordinary unimproved road."

Probably the most interesting photographs show some of the roads "before" and "after" taking the "concrete treatment." One of these is reproduced herewith. The upper view, "before taking," shows the sticky clay county road, almost impassible in spring and fall. The view below, to quote shows the same road, "Fit for Traffic any Day in the Year."

This report should be in the hands of public officials and road engineers who are responsible to the people for the highways of the country. It is an inspiring document.

MOTOR CYCLES AS CONSTRUCTION EQUIPMENT

The difficulty of adequate supervision when various pieces of work are being carried on at scattered points—a difficulty well known to contractors and engineers—has been successfully overcome by the A. S. Bently & Sons Company, builders, at Toledo, O., through the use of motorcycles. They

MOTOR CYCLE USED BY TIMEKEEPER ON CONSTRUCTION WORK.

were faced with the necessity of getting a timekeeper over the ground more than once each day, and a horse and bugggy was too slow. An automobile was a trifle expensixe—and a motorcycle, it developed, was just right. Mounted on his motorcycle, H. R. Rupp, their general time-keeper, was able to do practically the work of three men.

"The purchase of our first motorcycle," says L. S. Hillebrand, secretary of the company, "was occasioned by the fact that our contract work had become quite spread out in the city and it was very difficult for a time-keeper to get around to the various jobs more than once a day. That was in the spring of 1910.

"For instance we were at that time working at the Filtration plant, which is up the river; and also at the Toledo ship yards, which is down the river. The distance between these two places is some ten miles, and as it was our desire to have our general time-keeper visit each of these jobs twice daily, we decided to experiment with a motorcycle.

"Of course, in addition to these jobs we had various other work which took the time-keeper all over the city. This machine has been covering 75 to 80 miles daily, including the winter months, since it is necessary to use it constantly in all kinds of weather. We conservatively estimate that this machine and rider are displacing three men.

"The result has been, in adition to this general time-keeper checking up our other time-keepers, that we have also been able to have him handle the duties of a team superintendent as well. Since our first 'experiment' we have purchased three other motorcycles, all of which have given us the greatest satisfaction, as our experience has been very uniform.

"The expense of maintaining these machines has been nominal. We have had no great amount of trouble other than the wearing out of the tires which, of course, is to be expected."

BAFFLE BOARDS IN LONG DISTANCE GRAVITY CHUTES

In a recent issue of the *Engineering and Mining Journal*, W. F. Hartman, a mining engineer describes gravity methods in mine work which are of much interest. The concrete was "slid" through troughs from the mixer to the forms down in the mine.

These troughs were made of sheet iron bent to a diameter of 24 in., although sheets 18 in. wide could have been used. When this was first tried it was feared that there might be a separation of the concrete while sliding down the chutes, but by using brake boards, somewhat like the fingers used in finger chutes to retard the flow of the mixture, separation was prevented. The concrete piled up at each board, and when enough had accumulated to force its way past it did not go far before it encountered another. In this way the rubble was most thoroughly coated with cement.

It is no uncommon thing to slide the concrete down 200 ft. at this mine where the troughs have the same dip as the lode, approximately 38 degrees, and in one instance concrete was shot down 500 ft. At the first drop it slid 200 ft., then was reshoveled from a platform to the second line of chutes, 100 ft. long, and then by reshoveling after each of two more 100-ft. drops it reached the plat at the forms. There, as is usual in this concrete work where the mixture is shot down chutes, the concrete was turned over once before being shoveled into the forms.

The retarding board is nothing more that a 2 x 12-in. plank with a cross piece nailed to its upper end, by which it is fastened in the trough by a rope or wire going around the body of the chute. At the lower end of the plank old sacks are tied, which block the passage of the mixture until the weight of the accumulation is sufficient to force the board upward, permitting a portion of the mixture to pass under the end of the plank.

LUTHERAN CHURCH IN STEBEN, BAVARIA

Bath Steben in Bavaria has a Lutheran Church whose interior construction is of reinforced concrete. The framework of the roof had already been ordered and could not be changed. The same applied to the position of the rafters so that the entire upper reinforced concrete structure had to be built to conform with the roof framework. The concrete was computed for pressure in bending at 40 kg./cm.² (568 lb./sq. ft.) and with an axial pressure at 35 kg./cm.² (497 lb./sq. ft.) and the steel for tension at 1000 kg./cm.² (14,200 lb./sq. ft.). The floors of the gallery on the south and north side of the church are constructed as crosswise reinforced slabs with an effective load of 400 kg./sq. m. (80 lb. sq. ft.). The center fields and the outer edges of these slabs are 15 cm. (6 in.) thick and are reinforced with 130.4 in. steel rods running in each direction. The arches are round and the lower sides of the gallery floors facing the main body of the church are finished as paneled construction. The floors and beams of the choir and organ gallery are of the usual type and offer no special interest. The roof over the western main entrance is constructed as a freely supported slab. The railings or parapets of the galleries are also of reinforced concrete, are 15 cm. (6 in.) thick and form a type of open trellis work which has a very pleasing effect. They are spanned into the gallery floor beams.

The concrete construction of the upper portion of the church partly supports the heavy wooden truss work of the roof, and partly forms a fireproof interior structure to catch the falling timbers in case the roof should ever catch fire. The roof construction is computed for an effective load of 100 kg./m.² (20 lb./sq. ft.).

The roof over the northern entrance (Fig. 3) is constructed in part as barrel arch, in part as a straight slab. The arch is 5 cm. (2 in.) thick at the crown, and 8 cm. (3.2 in.) at the skewback. The reinforcement is double namely 10-7 mm. (0.2 in.) rods for principal reinforcement and 10.5 mm. (0.2 in.) rods to distribute the pressure. The outer reinforcement was not carried out entirely as the Fig. 2a shows. The slight horizontal thrust is taken up by the lateral beams.

The vaulted roof over the altar is a sort of cupola, can, however, be considered as a barrel arch whose supports lie very high and at unequal heights. The higher skewback, which is 8 cm. (3.2 in.) thick supports itself on the altar arch, while the lower skewback with a thickness of 12 cm. (4.8 in.) rests on the outer or skeleton walls of the church. The base of this arch is constructed as a circular ring to take up the tension, and the proper steel reinforcement is anchored in the adjacent walls. The small horizontal thrust is taken up by the altar arch, the church walls, and the circular tension ring. The ceiling over the organ gallery (Fig. 1) is a straight, freely supported slab.

The construction facing the roof truss work

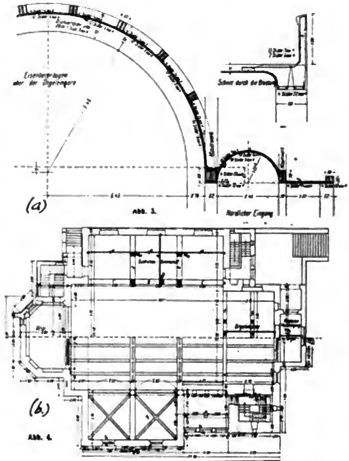


FIG. 2—STRUCTURAL DETAILS AND GENERAL PLAN OF CHURCH IN BAVARIA.

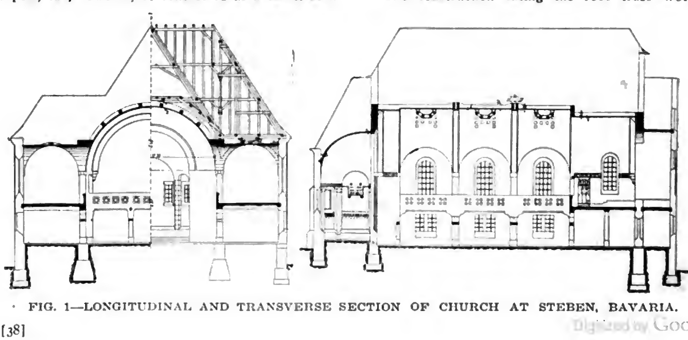


FIG. 1—LONGITUDINAL AND TRANSVERSE SECTION OF CHURCH AT STEBEN, BAVARIA.

over the north and south galleries is formed by five cross vaultings with a ground plan area of 5x5.35 m. (16.5x17.6 ft.). The caps or copings are crosswise reinforced slabs spanned between the groined arch, the binding arches and the adjoining church walls. The slab is 10 cm. (4 in.) thick, reinforced with 11-8 mm. (0.3 in.) steel rods. The binding arches are 60/40 cm. (24/16 in.) thick and have the same reinforcement as the groined arches. These have a span of 7.5 m. (24.7 ft.) with a rise of 2.35 m. (7.7 ft.), a cross section of 40x20 cm. (16x8 in.) and double reinforcement of each 4.12 mm. (0.5 in.) rods.

The arcade arches (Figs. 1 and 2*b*) are constructed as straight beams with the upper horizontal portions finished in form of arches. These arched beams are joined to the cross vaulting and to the vaulting of the center nave of the church, and unite the gallery pillars with each other, and also carry the heavy roof truss work.

The barrel arch over the choir and the center nave (Figs. 1, 2, 3) consists of three reinforced concrete arched rafters and of two plain concrete rafters with longitudinally reinforced concrete beams and reinforced concrete slabs spanned between them. These slabs with a span of 1.95 m. (6.4 ft.) are 6 cm. (2.4 in.) thick and are reinforced with 12-5 mm. (0.2 in.) steel rods. The longitudinal beams are continuous and have a cross section of 40/30 cm. (16/12 in.). The arch connecting the central nave and the altar is in plain concrete with a span of 7.52 m. (24.8 ft.). It is 60 cm. (24 in.) wide and 2.3 m. (7.5) ft.) thick at the crown with a rise of 3.3 m. (1.08 ft.).

The horizontal thrust is taken up by the adjoining walls. In order to lower this thrust, four strong steel rods were firmly imbedded into the skewback walls by means of hooks and these thus form a sort of anchorage. The two center reinforced concrete arched rafters (Fig. 2*b*) have a span of 13.1 m. (43 ft.) and consist of a circular arch with a radius of 6.4 m. (21 ft.) and two straight perpendicular pillars of 60 cm. (24 in.) diameter and a height of 3.1 m. (10.2 ft.). The reinforcement for these is of 4.28 mm. (1.1 in.) steel rods held together by round steel stirrups at distance of 20 cm. (8 in.).

The connecting arch between the main nave and the choir gallery is a reinforced concrete circular arch with a rise of 5.3 m. (17.4 ft.) and a span of 11.10 m. (36.6 ft.). The cross section of this arch is 1.1 m. (3.4 ft.) high and 40 cm. (16 in.) thick. The reinforcement extending through the entire arch is of 4.24 mm. (0.9 in.) steel rods, above and below. The horizontal thrust is taken up on the south side by the outer church walls and on the north by the interior reinforced concrete girder, which, with a span of 6 m. (20 ft.) is constructed in such a way, that it can take up the thrust as a single or concentrated load in a horizontal direction and transfer it to the adjacent wall construction.

The arch between the main entrance and the choir gallery is in plain concrete and similar to that between the altar and the central nave. It has a cross section of 1.75x0.8 m. (5.7x0.2 ft.).

The cross sections of the reinforced concrete columns, all of which have copings, and are under the choir gallery, are 40/40 cm. (16/16 in.), while those below the north and south gallery have 60/80 cm. (24/24 in.).

The greatest pressure on the ground is 2.75 kg. cm.^{2} (39 lb. sq. in.), the foundations being of plain concrete. All the inside surfaces are finished with a 3 cm. (1.2 in.) layer of white mortar worked in various designs. The concrete for the gallery floors and beams is mixed 1:5, that for arches and columns, 1:4. Fig. 2*b* shows a ground plan of the church. Fig. 3 shows some of the scaffolding and falsework during construction.—*Beton und Eisen.*

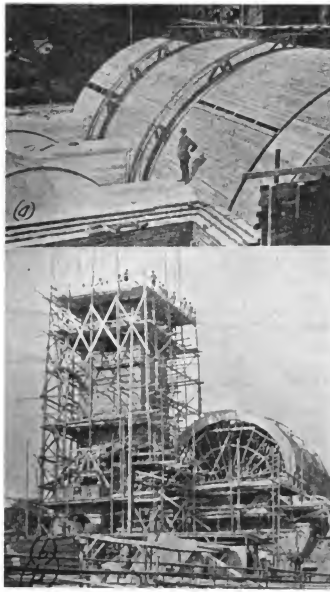


FIG. 3—CENTERING IN PLACE (a) FOR BARREL ARCH ROOF OF A BAVARIAN CHURCH, AND (b) GENERAL VIEW DURING CONSTRUCTION.

Demand for Cement in Russia

In contrast to the situation in other countries, it is interesting to note that according to the official *Commercial and Industrial Gazette,* (St. Petersburg), of May 17, there is a great lack of cement in Russia, and prices have risen of late by from 50 to 100 per cent. This is due to the rapid growth of towns, to sanitary improvements, public works, port improvements, and industrial and commercial building extension generally. The home production is quite insufficient to satisfy the demand, and the Moscow Goovernment Zemstvo is applying to the Minister of Finance for the remission of the Customs duty (of 12*c.* per pound, or about 9½*d.* per cwt.) on foreign Portland cement, and for reduced freight rates.

A REINFORCED CONCRETE RANCH PUMPING PLANT

THE building tower and tank for the pump house on the ranch of T. D. Torrey at Lindsay, Cal. are constructed of reinforced concrete with plastered exterior surfaces and clay tile roof. There is a reinforced concrete ceiling slab with wood framed pitched roof over it. The dimensions of the pumping house are 23½ x 45½ ft. In point of design and construction the tower is unique. There is a well 6 ft. in diameter and about 20 ft. deep with reinforced concrete casing directly under it and in order to give a clear space in the pumping house the tower was carried up on beams supported by columns built into the side walls. The columns rest upon footings 4 ft. square 8 ft. below the ground. Directly under each of the four columns is a steel plate 18 in. square and ⅝-in. thick. The columns are 18 in. square and the reinforcement in each consists of four 1-in. round steel bars. The principal beams, which have a span of 19 ft. between the columns, are 24 in. deep and 15 in. thick, and the reinforcement consisits of eight 1-in. longitudinal steel bars with ⅝-in. spacing bars and ¼-in. stirrups spaced from 4 to 8 in. The transverse beams are the same size as the principal beams with a span of 6 ft.

The legs of the tower, four in number, rest upon the centers of the beams with a cantilevered corbel at each point of juncture. There are four 1-in. steel bars in each leg. All the heavy vertical bars have ⅛-in. ties 12 in. on centers. The legs of the tower are tied together at the top by 3-in. steel "I" beams.

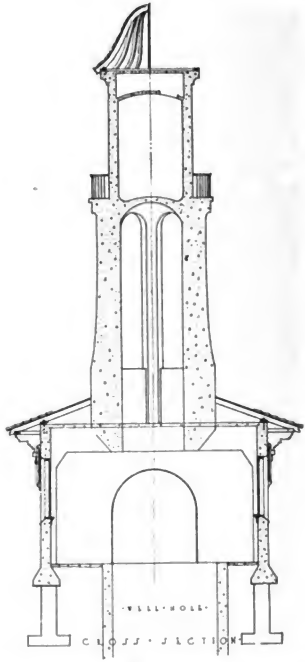


FIG. 1—LATERAL AND LONGITUDINAL CROSS SECTIONS, T. D. TORREY PUMPHOUSE.

FIG. 2—REINFORCED CONCRETE PUMPHOUSE, TANK AND TOWER, T. D. TORREY ESTATE.

The water tank, which has a capacity of about 3,000 gals., has a bulging bottom 6 in. thick at the apex. It has an inside diameter of 6 ft. with 3-in. shell and a reinforced concrete cover, making it a huge monolithic bottle. The roof of the tower is carried on four columns run up from the circular platform with the shell of the tank.

The plans for the building and tower were made by Archt. Norman F. Marsh of Los Angeles. It was built by Guy S. Bliss of Pasadena on a percentage basis. Cost, $7,000.

MECHANICAL PROBLEMS OF CEMENT MANUFACTURE

During the past year, the American Society of Mechanical Engineers has had a very interesting and valuable symposium on certain mechanical problems of the cement industry. Three of the papers were as follows:

Some Problems of the Cement Industry:* By Walter S. Landis (published in *The Journal* for April).

An abstract of the paper states that progress and improvement in the cement industry has and will resolve itself into the development of the plant as against the process. The chief features of interest in this plant development are the question of size of first crushing unit, the fineness of grinding of the raw materials before entering the kiln, the gradual displacement of the wet process by the dry one, better utilization of the fuel in the clinkering of the raw material, and the abandonment of the air separator. The older mills must be remodeled along the lines of more economical power distribution and labor requirements to compete successfully with the modern mills, now that profits in cement manufacture have dropped so low.

The Edison Roll Crushers: By W. H. Mason (published in *The Journal* for April).

The causes according to an abstract of paper leading to the design of the Edison crushing rolls are outlined and a comparison made of the energy of coal as compared with dynamite in breaking up stone in the quarry, with a description of the method of quarrying now employed in conjunction with Edison roll crushers. These rolls store up kinetic energy for use in crushing and sledging large stones and a comparison is made in this connection of rolls of various sizes. The power required for crushing by this method is shown by tachometer records, from which speed, energy and horsepower curves are plotted. Records are given covering a period of two years of time lost and the cost of repairs on the crushing plant at the Edison Portland Cement Company. Comparisons are made between the theoretical capacity of these rolls and the actual capacity as shown by tests. Both of these are enormously greater than for the gyratory crushers and in addition, the larger size of the stones which can be handled by the rolls greatly simplifies and cheapens the quarrying operation. The crushing plant of the Tomkins Cove Stone Company which has a capacity of 1,000 tons an hour, is described.

Power and Heat Distribution in Cement Mills: By L. L. Griffiths (published in *The Journal* for June).

An abstract states that the paper compares the methods used and the results obtained in five different cement plants for converting the thermal power of the fuel into productive mechanical work. A brief description is given, both of the power installation and of the mill arrangement; and the relative efficiences of different raw materials, types of grinding machinery and engineering arrangements are considered. The data are such as to enable comparisons to be made between the same types of machinery, and in most cases, the same size and make of machinery, at least in individual departments if not throughout the entire plant.

*Published in "Cement Age," June, 1911.

FEEDER FOR TUBE MILLS

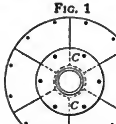
In a recent issue of the *Engineering and Mining Journal*, H. Sharpley, superintendent of the Blackwater Mine, at Waiuta, New Zealand, describes a feeding device for tube mills, so made that it can be reversed by changing the manner of bolting the parts together. The advantages of such a feeder are that it is a simple matter to make the change when it becomes necessary to reverse the direction of drive; it is made in sections that may be readily renewed; pebbles, once in the lifting chamber *L* cannot fall back into *R*, the receiving chamber, and being "built up" is cheaper to construct than a solid casting. The feeder consists of five parts, *R* is the receiving chamber, *S* the lifting chamber, *C* the connecting flange, and *D* a division plate with the inlet hole of suitable area, which area is governed by the sectional area of the trunnion of the mill. The plate *D* is bolted between *R* and *S*, as shown in Fig. 2, in such a position that *I* comes on the spiral side of the division at *E*, Fig. 3. At *F*, in Fig. 2, is shown a division plate, which is placed between *S* and *C*, and in which there is a hole corresponding in position and diameter with the inner diameter of the tube mill trunnion.

To reverse the feed it is only necessary to loosen the bolts and change *S* from the position shown in Fig. 3 to that shown in Fig. 4, and tighten again the bolts that hold the parts together.

Concrete Culverts and Bridges

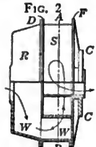
Not a little of the success of concrete culverts is due to the growing recognition of the adaptability and economy of concrete for construction. In the early days of road building timber was the material most frequently employed in culverts and short span bridges on country roads. The life of timber is short, and consequently the bridges and culverts built of it required constant maintenance and frequent replacement. In addition there was always danger from undiscovered weaknesses in the structures, loss by flood, and, in the case of long bridges, the likelihood of their destruction by fire.

Fig. 1



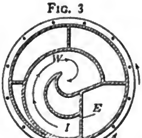
Plan

Fig. 2



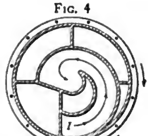
Half Section - Elevation

Fig. 3



Section *A-B*

Fig. 4



Section *A-B* Reversed.

A REVERSIBLE FEEDER FOR TUBE MILLS.

REINFORCED CONCRETE JIGS IN MINE WORK

IN a recent issue of *The Engineering and Mining Journal,* Frank J. Strachan, superintendent of concentrators, Cananea Consolidated Copper Co., Sonora, Mexico, describes an interesting use of reinforced concrete jigs.

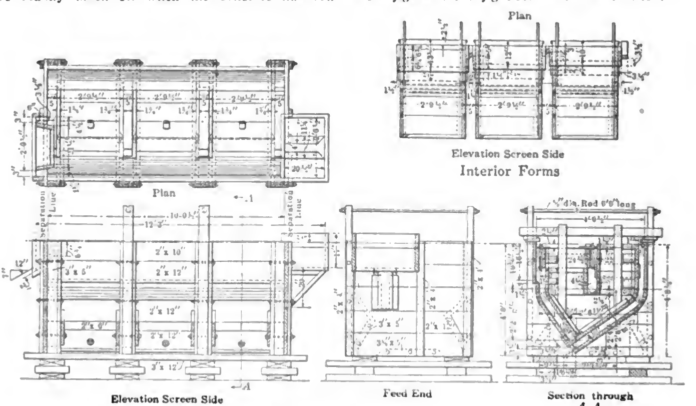
The new, or No. 2 concentrator of the Cananea Consolidated Copper Co. began to operate about eight years ago. The 42 jigs used in this mill were made of clear selected Douglas fir plank 3 in. thick, with 8 x 8-in. posts, and were the ordinary type of Harz jigs. Possibly owing to the acid water the wood of these jigs has been attacked by dry rot and some of them have become so weakened that it has been necessary to replace them. With the permission and approval of the management, I have designed and built three reinforced concrete jigs, and propose to install two jigs a month until all of the jigs in this mill are replaced by the new type. The accompanying cuts show the form for the construction of these jigs, and the jig itself after construction.

The walls and partitions of the jig are of concrete 3 in. in thickness, and are made of a mixture of 1 part of cement to 2 parts of good, sharp sand that has been thoroughly washed and which will pass a 2-mm. screen. The walls and legs of the jig are reinforced with iron screen of 1½-in. mesh, made of wire 1/8-in. in diameter. The screen is fastened in place before the concrete is poured. The partitions and legs are also reinforced with a few bent rods of ¾-in. steel, as shown in the cuts. The concrete is made sufficiently liquid to assure the filling up of all small crevices and openings, and while it is being poured a man constantly raps the form on the outside to insure proper packing and the expulsion of air.

The construction of the form is such that it can be readily taken off when the concrete has set. Thirty-six hours was the time allowed for setting in the manufacture of the first two jigs. When the form is removed the inside of the compartments of these jigs is washed with a waterproof coating. This coating is made as follows: A mixture is made of 1 lb. of concentrated lye, 5 lb. of alum, and 2 gals. of water. To 4 pts. of this mixture, 10 lb. of cement are added and thoroughly stirred. This compound is applied to the interior of the jig with a brush and several coats are given. This formula is taken from Reid's "Reinforced Concrete Construction," and seems to be an absolutely waterproof mixture, since there is no indication of leakage and the jigs have been in operation for over a month.

The shafting, bearings, eccentrics and plunger rods on these jigs are taken from the wooden jigs that have been replaced, and in the costs given below this material is not included. The brackets for the support of the shafting and pulleys are made of cast-iron and weight 70 lb. each. They are machined on their upper surfaces only. This is done to facilitate leveling, as well as to make a good set for the bearing for the shaft. These brackets rest on the concrete wall of the jig and are anchored with ¾-in. bolts imbedded in concrete.

The cost of the first two jigs set in place, including the cost of the form, is as follows: Cement, $51.20; nuts, bolts, washers and nails, $5.32; reinforcing, $27.84; castings, $19.60; 16 lb. rail, $2.16; total supplies, $106.12. Carpenter foreman, $78; carpenters, $185; other labor, $59; total labor, $322. Total cost of two jigs, $428.12. Since then, using the same form, a single three-compartment jig has cost as follows: Cement, $25.60; nuts and bolts, $2.48; reinforceing, $13.92; castings, $9.80; 16 lb. rail, $1.08; screen frame, $6; lumber, liners and wedges, $6.32; total supplies, $65.20. Carpenters, $40; other labor, $9.85; placing jig, $30; total labor, $79.85. Total cost for one jig, $145.05. The accompanying cuts show the form for the construction of these jigs and the jig itself after construction.



Exterior Form

FIG. 1—FORMS USED FOR REINFORCED CONCRETE JIGS.

A Hollow Concrete Dam

W. W. Colpitts, M. Am. Soc. C. E., describes in a recent *Engineering News*, an engineering project in Texas in which an irrigation dam and reservoir are leading features. The dam is on Alamito Creek, Presidio county.

The dam site is a narrow rocky gorge of solid homogeneous rock throughout, without faults or fissures of any kind. The dam is the Ambursen type and was designed by the writer. It is built to permit of raising it at a future date to Elev. 4485, should the necessity arise, and with that in view, the horizontal bars in the buttresses extend 3 ft. beyond the rear, to aid in bonding the new concrete of the extension to the old. The face wall is of 1:2:4 concrete, trenched 3 ft. into the rock, reinforced with 1¼-in. round, corrugated, high elastic limit bars. The sections were designed under working stresses recommended by the American Railway Engineering Association. Shearing and diagonal stresses are resisted by bending up the ends of the horizontal bars rather than by stirrups, because of the greter convenience of placing the former. The horizontal bars were bent cold, with a bending machine, and accurately spaced by means of patent spacers.

The buttresses are of 1:3:5 concrete, put up in lifts of 6 ft., the upper surface of each lift being notched to resist longitudinal shear. The buttresses are also trenched into the rock.

Details of the dam are shown in drawings and also a view of the rear of the dam during construction.

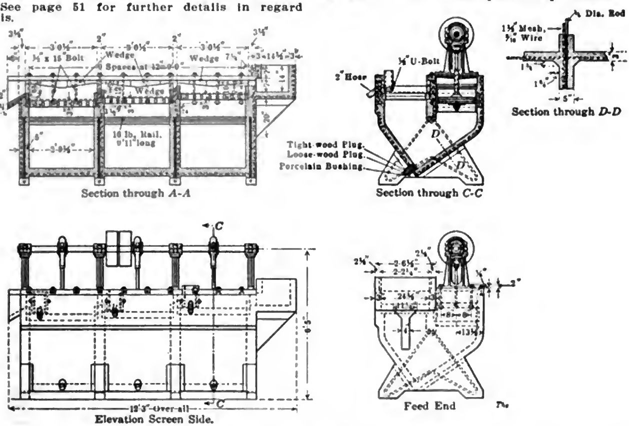
Influence of Transport on Properties of Concrete*

A novel industry lately originated in some German cities is the preparation and supply of ready-mixed mortar and concrete. These materials, says the London *Builder*, are prepared in special works and transported thence to building works in progress. There can be no doubt that the plan of mixing under expert supervision should be beneficial in itself; while, on the other hand, it is to be feared that the delay, inseparable from loading, transport, and delivery, may affect the setting of the mortar and concrete, and that the jolting of concrete on the way from the mixing works may cause segregation of the constituents. In order to obtain reliable data on the two points in question, tests have been conducted on a series of specimens of concrete, taken before and after transport. According to the results furnished by the tests, it appears that the transport of concrete actually increased the strength of the material by about 15 per cent, the increase being more noticeable in cases where aggregate with sharp edges had been employed. We are reluctant to accept this conclusion for general guidance, and besides, it is highly probable that in ordinary practice delays would occur in delivery, presenting considerable risk of inferior work.

*See page 51 for further details in regard to this.

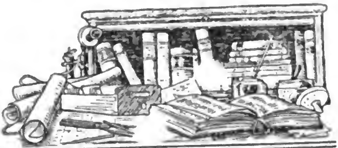
Concrete Bridges

At present the practice of the more progressive communities is to put in concrete bridges and culverts, where possible, as fast as it becomes necessary to replace wooden structures. Although by no means limited to use for short spans, concrete is employed in country road work chiefly for structures of spans up to about fifty feet. For such work it possesses a number of advantages. In the first place, a properly built concrete bridge or culvert is a permanent structure, which, when the absence of maintenance charges is taken into account, is often found to be the cheapest. Moreover, concrete is a material that can be handled with comparative ease and that can be used with a working force of relatively unskilled labor, providing that the work is carried on under competent supervision.



REINFORCED-CONCRETE JIGS AT CANANEA

FIG. 2—THE FINISHED JIG.



CONSULTATION

Correspondence Study Courses at the University of Wisconsin

The editor of the Consultation Department has had numerous inquiries concerning the correspondence-study courses in structural engineering offered by the Extension Division of the University of Wisconsin. In nearly every case the question has been asked whether this instruction could be obtained by persons living outside the State of Wisconsin. We wish to advise our readers that this opportunity is open to all prospective students, and complete information can be obtained in regard to this work by addressing the University Extension Division, University of Wisconsin, Madison, Wis.

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178. Wood Finish Floors on Structural Concrete Base With Tar Bedding

"Assume light building construction such as office buildings and school house floors, where it is necessary to secure a wood finish floor over a structural concrete base. Is there any data on the following suggested specification?

"Use 1-in. boards, rough, imbedded in a tar-sand mixture spread upon the concrete base, no more thickly than to make up for unevenness in the concrete surface, and to give a uniform surface. To this nail the finish flooring.

"This is suggested to eliminate the necessity of using sleepers imbedded in concrete, for in light of Prof. Woolson's discussion (Consultation 160, March, 1910),‡ we run therein the risk of dry rot.

"What is the possibility of disagreeable odors from the use of tar?

171. Discussion by John T. Simson*

In reference to the wood flooring used on structural concrete, as laid by us in our school house construction, the floor is laid in the following manner:

At the completion of the concrete floor slab, a 1-in. footing of sand is placed on top of the same and brought to a true level by screeding. On top of the sand is placed 1¼-in. boards, laid diagonally and nailed together at the edges. The form lumber used for centering is usually used for this work. On top of the 1¼-in. boards is then placed building paper, which in turn is covered by the finished flooring. Floors have been laid in this manner in a number of school buildings with excellent results.

*Pres. American Concrete-Steel Co., Newark, N. J.

‡"Concrete Engineering."

210. The "Colloidal Theory"

"Two years ago we heard continually about 'colloidal theory.' The technical papers were full of 'mineral glue' talk. To-day this seems to have quieted down to a remarkable degree, and we hear nothing further of it. What is the present status of the 'colloidal theory'."

210. Discussion

The term "colloidal" is applied to an amorphous form of matter, and it broadly includes everything that is not crystalline. Usually, however it is applied to a gelatinous mass of finely divided particles suspended in a liquid, but not as a true solution. It is distinguished by its failure to diffuse. It approaches or reaches a solid condition, or it may be in a quite free state of suspension.

210. Discussion

In a recent paper read before an English technical association Dr. C. H. Desch says in part that the theory of the setting of cements due to Le Chatelier, depending on the interlocking of crystals growing from neighboring centers, fails to account for the great mechanical strength attained by cements. On the other hand, the late Prof. Michaelis attributed the setting to the formation of colloidal products. Microscopical examination fully confirms this view. The action of water on the alike cyrstals of the cement brings about hydrolysis of the aluminates and silicates present. The hydrated calcium aluminate formed during the initial set is chiefly crystalline, but the hydrated calicum metasilicate formed during the principle setting process, being extremely insoluble, separates as a colloidal gel. A portion of the lime set free crystallizes, the remainder is at first in solution. The gradual hardening of the cement is due in the first place to the shrinkage and dessication of the gel, a part of the lime being absorbed at the same time. This absorption may continue for a long period, lime gradually penetrating further into the dessicated gel, increasing its hardness and strength.

The process may be followed by means of the microscope, especially when advantage is taken of the differential staining of colloids by dyes, such as safranin and patent blue. In the study of clinker, the difficulty hitherto found has been that of grinding sufficiently thin sections of so brittle a material. This may be avoided by treating the clinker in the same manner as a metallo-graphic specimen; that is, by grinding and polishing one surface only, etching lightly with water or acid, and examining by vertical illumination. This method may also be applied to mortar after setting. The application of Michaelis's theory throws an entirely new light on the process of setting, and gives an explanation of many points which were previously obscure.

212. Power Equipment for Saw Mills

"I am about to install a job with a saw mill, and am in doubt whether to buy a power equipped self-contained machine, or simply a saw table which can be run by a belt from the mixer engine."

212. Discussion by W. P. Anderson*

In reference to using saw mill on job, I think it is better to equip mill with separate power and not use the mixer engine for running the mill. A mixer runs at a great deal less speed than a saw and it would require pretty large pulleys to get required speed on the saw. Besides, it is not always convenient to place the saw shed next to the mixer and we believe it will be a good deal cheaper and better to have separate equipment. If electrical power is accessible about a 10 H. P. Motor is very convenient.

217. End Anchorage of Rods in Flat Slab Construction

"How are the floor reinforcing rods anchored at the wall columns of the flat slab construction?"

217. Discussion by C. A. P. Turner†

As regards the "Mushroom type," I would say that it is treated just the same as the old style beam and slab construction. We make no difference between the two. In building into old walls we notch the wall, dove-tailing the cuts: that is, alternating with a deep cut and shallow cut so as to keep the wall intact in casting into it and we pursue exactly the same method whether we are using flat slab construction or beam and slab construction.

225. Vibration in Foundry Buildings

"Have you any data on the design of foundry buildings several stories in height, in lieu of the one-story design? In the construction of such a building, would there be any danger of vibration from the jarring machines, such as are used in foundry work?"

226. Bond Stress in Beam Design

"In a reinforced concrete beam with a number of the horizontal rods bent up to provide for diagonal tension, what is the bond stress along the remaining horizontal rods near the end of beam as compared with the stress which would exist along such rods if all the horizontal rods were continued straight to the end of beam? What rules can one follow in regard to this part of beam design?"

*Cincinnati, Ohio.
†Minneapolis, Minn.

227. Ultimate Load Formula

"For what reasons are the straight line formulas for reinforced concrete beam design based on working stresses to be preferred to the ultimate load formulas based upon a factor of safety? What difference results in the design of a given beam?"

228. Stirrup Spacing in Beam Design

"How is stirrup spacing determined in a beam subjected to both concentrated and uniform loads?"

229. Transverse Reinforcement in Unit Slabs

"Are data available from tests of rectangular reinforced concrete slabs, supported on the long edges, and given a concentrated loading at the center as to the width of such a slab which may be considered as a beam carrying the concentrated load to the two supports? How does the percentage of reinforcement parallel with the supported edges and its position relative to the reinforcement from support to support affect the strength?"

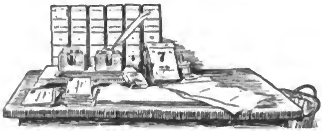
230. Making Expansion Joints Watertight

"Have had some trouble with cracks in a porch floor, and the use of bitumen filled expansion joints has been suggested. Can you explain to me a little more fully how a bitumen filler is used in expansion joints, for with any filler in a joint of this sort, I should think it would be squeezed out when the concrete expands and then leave a crack when the concrete contracts again."

Keeping Concrete Moist to Prevent Cracking

The *Journal of the Association of Engineering Societies*, September, contains an article by Alfred D. Flinn, from which the following interesting statements are taken:

Tests show that concrete, which hardens wet, suffers little or no shrinkage and is denser than that which hardens dry. Examples of the value of keeping concrete wet came to the writer's attention on a recent visit to Portland, Ore., and Seattle, Wash., in both of which cities large new distributing reservoirs were being lined with concrete. In both places effectual care was exercised to protect the freshly deposited concrete from the hot sun and to keep it well moistened by almost continual spraying. As a result, so the writer was informed, no cracks were observed in acres of lining 7 or 8 in. thick, divided into blocks about 16 by 30 ft. The proportions of the concrete at Portland were 1.2.4 and at Seattle 1.3.6. In both places a layer of mortar was applied to the top before it had hardened. About four years ago the writer built a reinforced concrete house about 42 ft. square, with walls 8 in. thick, lightly reinforced with round rods. The concrete was kept moist and to date no cracks have been discovered. It is absolutely proof against hard rains and all other moisture, although there are no air spaces in the walls and the interior plaster was applied directly to the concrete, without furring. The mixture was 1 part of Vulcanite cement, 2 parts of Cow Bay (Long Island) sand and 4 parts of ¾-in. broken trap rock, deposited quite wet.

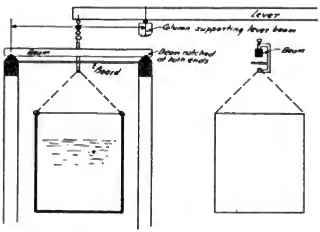


CORRESPONDENCE

The "Control Beam" for Testing Concrete

Relative to Dr. Von Emperger's "control beam" for determining the quality of concrete, whilst I have not as yet tried this method of testing, in my opinion it is superior to the present method of testing, namely, by crushing cubes. Over this it has the following advantages: (1) the cost of the apparatus is less, (2) there is less liability to error under the ordinary conditions of field testing.

I would however, suggest the following modifications to his apparatus and method, namely, (1) instead of supporting the load at two points on the beam, use one central support. This would lessen the load required and eliminate one possible source of error, namely, that of the chains being unevely loaded, (2) substitute a water tank for the platform and make the test with water; (3) attach the tank or platform as the case may be to a lever so that it can be readily replaced and placed as required.



SKETCH ILLUSTRATING MODIFICATIONS TO "CONTROL BEAM" EQUIPMENT.

The accompanying sketch illustrates these modifications. These suggestions of course relate to minor points only, and in no way are they intended to detract from the merits of Dr. Von Emperger's recommendations which should be fully recognized.

ERNEST L. RANSOME.

Consulting Engineer,
New York.

THE QUANTITY SURVEYOR

[On another page of this issue is published a description of the English method of "quantity surveying." The following opinion of this, from the view point of architect, engineer and builder, is of interest and value. The question deserves careful consideration.—EDITORS.]

To my mind the employment of a quantity surveyor should eliminate the great variation that is at present observed in the estimates for almost every operation. This variation is a source of wonder to every client and far too often it means a mistake on the part of some bidder.

An architect is often forced, even against his better judgment, to accept the lowest bid, and this quite often results in the unpleasant task of holding a contractor to the specifications while knowing that he is losing money.

To any one expecting to establish himself as a quantity surveyor, I would suggest that government work would offer the best opportunity for a try-out. As it became better known it could be extended to all kinds of work.

CHARLES S. KEEFE.

Architect, New York City.

In the English custom of having a surveyor for taking off quantities for estimating building, as I understand it, the owner is responsible for the surveyor's quantities and if the surveyor makes an error and more material is required than he states, the owner would have to pay the contractor for the excess. I am not prepared to say whether this system would work in this country or not. Of course, in municipal work, it is customary for the city engineer to make estimate of quantities in any work although the work may be bid on in a lump sum. He does this in order to estimate the cost for the required appropriation. Very often, however, his figures are too high, as he would sooner have the appropriation higher than the bids and therefore, purposely makes his estimate a little bit high. The consequence is, the contractor does not know how much too high it is and takes off his quantities anyway. Of course, it would be a fine thing if contractors did not have to take off any quantities, but I think it would be pretty hard to get any one else to take these off and have the contractor accept his figures unless there was some way of guaranteeing his quantities.

W. P. ANDERSON.*

*President The Ferro Concrete Construction Co., Cincinnati, O.

I think the idea a good one. I have talked with several contractors and architects relative to it and find several opinions, though all think the idea is desirable in some form. One contractor told me that the large roofing concerns were doing this now. They pro-rate the cost of keeping two men to take off quantities, and furnish to all the firms interested.

The contractor doubted the efficiency of it. He had been watching the above firm's bids and they were found to be as wide apart as before they had the two men. One architect did not think the scheme a good one, worked out in this way. It was his opinion that the quantities should be furnished by the architect when plans are given out. The maker of the plans should know better than any one what should go in. In talking with the contractor about this he thought it gave to the unfair architect too much chance to stand in with some one builder.

Personally I think that to have the architect furnish quantities would be a good idea. There would be less chance for mistakes to occur. It is especially good if he guarantees his quantities. I believe the article is along the right road and an improvement on what we now have.

C. R. KNAPP.

Constructor, Philadelphia, Pa.

The introduction of a factor in the building trade, or for that matter in any line of business or manufacture, tending to eliminate waste and concentrate the working forces to the greatest efficiency at the smallest expense is an economical axiom, which is at present not sufficiently understood in this country to be generally adopted and applied. The true expression and application of this principle is found only in our so-called "trusts," which means nothing else but elimination of waste, elimination of competition which is waste, elimination of scattered manufacture, which on account of complicated management is waste. The greatest expression of this principle is the continuous introduction of labor-saving machinery which if not done means waste. Why we are fighting the principle of this immensely economical grouping, which is nothing else but a result or fact expressing the crystallization of human labor and inventive genius of our civilization, is not the place here to explain, but the irresistable force of education of the multitude which holds and controls the working lever of this immense machinery will some day find a solution for benefiting of all mankind which was created by all mankind.

The organization of our Builders Exchanges in cities and towns was of great value and benefit to the individual members, which advantages I cannot compile now. But as an organization for the material benefit it is in my estimation the only proper place for creating an office or employ a force of experts as "Quantity Surveyors."

The advantages and the salvation for the individual members, the attraction of new members, closer understanding and co-operation among themselves, also better control of the material market are points to be worked out by the exchanges themselves. As I understand the Minneapolis Builders and Traders Exchange, through its secretary, Mr. Young, is seriously contemplating to establish an office of a "Quantity Surveyor." From the standpoint of an architect I cannot too strongly commend an office of this nature, which is in general practice in England and the Continent where the architects submit with plans a "Quantity Survey" to the contractors to bid upon. The advantages of having expert estimators go over the plans and specifications which are in many cases in the time allowed not understood by contractors, plumbers, steam fitters, etc., and giving them the list of material to bid upon are of great value to the owner, architect and contractor. Most of the average contractors bidding have not the time to spend looking over the plans and as a general rule are always behind in submitting their bids at the stipulated time. This is a waste not only for them, but also for the architect and owner. Then the absolute necessity of asking questions and additional information before sending in the bid from the architect are energies spent uselessly.

Also the corrections or changes made by the architect during bidding on a job which corrections or changes require a great amount of time to inform each bidder of the same. Then there is the final suspense of contractor before opening of the bids, whether or not he forgot this and that; and on the other hand the overestimating of material and labor. This system would also give the chance of bidding on a certain job to many contractors which in the majority of cases have no chance of obtaining the plans for any length of time.

Taking all in all, it would be a step in the right direction to simplify the working between the architect, contractor and owner and save many an unnecessary trip and many a mistake and insure an improvement and higher standard in workmanship which in many cases has to be "skinned" on account of under-bidding, etc. Said "Quantity Surveys" should be submitted also to the architect for his information and scrutiny.

I hope that the publication of this in CEMENT AGE will create interest among the contractors and architects to promote the idea, as it certainly would benefit all parties interested in the advancement in the building trade.

C. B. STRAVS.

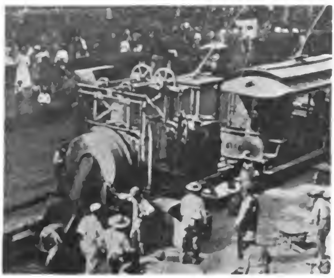
Architect, Minneapolis, Minn.

[Further discussion of the "quantity surveyor" is invited.—EDITORS.]

SUMMARY OF CURRENT CEMENT AND CONCRETE LITERATURE

Electric Car for Concrete Mixer

The electric street railway company in Los Angeles, Cal., has mounted a concrete mixer on a trolley car for use on the concrete work being done in connection with the reconstruction of its roadbed. Instead of having a mixer operating in the street alongside the tracks, it has found it more economical and effective and a great saver of time to have the mixer working right on the tracks, and it can be moved any distance back or forth as required at a moment's notice. The concrete is emptied from the mixer into a chute, which can be moved from side to side so as to deposit it at any given point between the ties. A great deal of hand labor is thus eliminated, as all the spreading is done by the machine. Power for operating the mixer is derived from the overhead wire. A small car for carrying tools, etc., is attached to the rear of the mixer car.



CONCRETE PLANT MOUNTED ON MOTOR CAR.

Early Use of Natural Cement In Pennsylvania

The Chambersburg, (Pa.) *Spirit*, publishes frequent contributions from a resident of the town, whose research has made him known as Historian McCauley. In a recent issue Mr. McCauley writes entertainingly of early use of natural cement, the manufacture of which at one time was a local industry of importance. The following are extracts from his article :

One of the most important of the many lost industries seems to have been entirely overlooked, although its product was the forerunner of one of the materials that is largely used today. Located at Scotland was an establishment called the Cedar Grove cement mills, conducted by J. Garver & Company. The company was prepared to furnish cement in quantities large or small, one barrel or a hundred on short notice.

There was great demand for this material and it was used by nearly all the masons of that time in this locality. John Forbis pronounced it the best he had ever used. C. Eakles said that it was superior to any other for building cisterns or wells in damp places. The late James A. Reside said that he had used it in the construction of the Carlisle water works, and also at the "Newville Works," and found it to be as good an article as he had ever used.

Abraham Myers, civil engineer, used it in building the gas tank for the Chambersburg Gas Company and found it to be the best American hydraulic cement after an experience of ten years. He said that stone masons in mixing it in many cases drowned the cement so completely that it would run from the stone and set afterward which no other cement would do.

During the year 1854, A. F. Smith, superintendent of the Cumberland Valley Railroad, directed the construction of the Carlisle Water Works, and the works of the railroad company, and had during that year used more than eighty barrels of this cement, and he pronounced it a good reliable article.

Concrete Floors and Motor Trucks

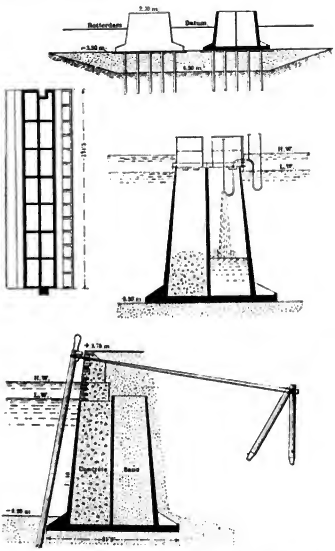
Discussing motor trucks, *Engineering News* says there are large possibilities in the use of motor-propelled vehicles in industrial plants, shops and warehouses in place of the industrial railway or the overhead carrier, both of which systems are in extensive use. With present-day shop floors of concrete motor trucks can be run over them with little more friction than over the rails of shop tracks. A great advantage over the rail system is that the trucks can be run anywhere. There is no stoppage for turntables or switches, or because of cars blocking the line ahead, as happens so often with industrial railways. In such a system, where current for charging is available at low cost and where the loads to be hauled are light, storage battery trucks appear to have great promise. The extent of this one field alone is so great that it will tax the ability and enterprise of many engineers and many manufacturers to adequately cover it.

Government Interested in Concrete Bridges

A significant step taken by the United States Office of Public Roads is the formation of a branch termed the Division of Highway Bridge Engineering, with Prof. W. H. Burr as consulting engineer. The Government strongly urge the construction of plain and reinforced concrete bridges and culverts, and particular attention will be paid by the new department to educating the people in the advantages of concrete bridges. Standard plans will be prepared for bridges of spans up to 30 ft., so as to be ready for supply, together with specifications and plans for molds and centering, to highway engineers and authorities. This authoritative advocacy of concrete and reinforced concrete should serve to remove any lingering doubts as to the desirability of such material in bridge building, and at the same time to counteract the prejudicial statements occasionally emanating from persons interested in rival materials and methods of construction.

New Type of Concrete Caisson

The Architects' and Builders' Journal, London, describes a new type of reinforced concrete caisson for quays and wharves adopted at Rotterdam, in view of the fact that, owing to the underlying soil being composed almost entirely of sand, pile foundations are unfavorable.



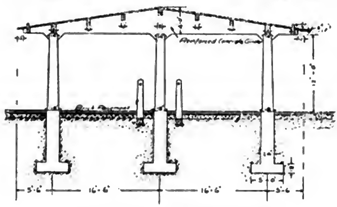
A NEW TYPE OF CONCRETE CAISSON.

The caissons are built in sections 134½ ft. long, 32 ft. 9 ins. high, and 31 ft. 10 ins. wide across the foundation. Each section contains 20 compartments separated by a longitudinal wall into two rows of 10 compartments. They are cast in wood forms on a raised platform alongside a basin or lock with sufficient water for launching, and when afloat are towed to the site and sunk by means of weights and water siphoned into the compartments. In order to guide them while sinking, a dovetail joint is made at the ends. For filling, a heavy metal plug was placed over four compartments, two in the front and two in the rear, and the water lowered half way by means of a pulsometer, after which concrete was poured into the front row of compartments: the back row being filled with sand by means of an elevator. The superstructure was built with a timber facing backed with concrete from low water up to about 10 ft. above high-water mark. The face of the caisson and quay is built on a batter inward from the bottom up. As a protection for the wharf, long piles were driven at the toe of the caisson, extending up to a point a few feet above the top of the upper planking. These piles were tied to short anchor piles by means of heavy timbers about 60 ft. long.

A Hitching Shed at a Market

The *Municipal Journal* describes a concrete hitching shed, built as an adjunct to a new market at Madison, Wis.:

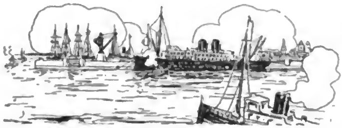
The hitching shelter or shed consists of a roof supported upon six sets or bents of columns, three to a set, under which, down the center line, is a double rôw of posts carrying a rod to which the teams of farmers and others may be hitched. Each set of three posts is connected at its top with a reinforced concrete girder, and the roof also is of reinforced concrete and is covered with green tiles similar to those used on the market building. The supporting posts are constructed of concrete, the foundations being carried several feet below the surface. These foundations are 5 ft. square by 18 ins. thick. The posts which they carry are 24 ins. square at the foundation level, reduced to 18 ins. square at the ground level and 14 ins. at the top. The reinforced concrete girder extends 4 ft. 6 ins. beyond the centers of the outside posts, and the roof overhangs 12 ins. beyond this. This girder is 4 ft. deep at the ridge and about 8 ins. at the outer ends.



SECTION OF HITCHING SHED.

The hitching posts are of concrete carried about 2 ft. below the level of the pavement. Through each post near the top is a hole through which is passed a wrought iron pipe which serves for hitching purposes, this pipe being continuous through the entire line of posts and furnished with an iron knob on each end to prevent its removal. This line of posts extends the full length of the shed and approximately the same number are continued in a straight line beyond the end of the shed.

The floor or pavement under the shed and that over the entire unoccupied area of the property between roadways is paved with brick on a concrete foundation. This pavement slopes from the market and shed both ways toward concrete gutters which are constructed around the market area between it and the roadways of the adjacent streets. About 3 ft. inside of each gutter are a number of garden plots, six being spaced equally along each side of the market area. These are surrounded by concrete curbs and planted with trees and shrubbery.



FOREIGN NOTES

Translations made especially for CEMENT AGE by F. W. Scholtz

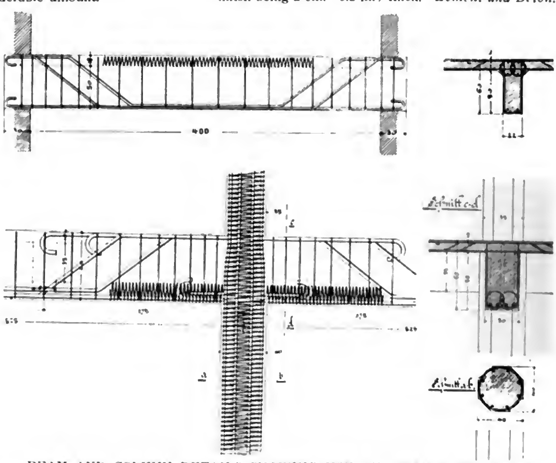
Concrete with Spiral Reinforcement

The Wayss and Freytag Co., in Neustadt have issued a 55 page booklet on the theory and practice of concrete columns, beams and girders, reinforced with spiral steel wire. The theoretical part gives a short synopsis of various articles that have appeared in the technical press on the same subject, and the results of tests made in the French and German Government laboratories in this line.

The second portion of the booklet gives an outline of the government specifications for this type of reinforcement in Germany, France, Switzerland and Austria.

The third part takes up the practical application in construction work, illustrating the use of spiral reinforcement in girders, beams, columns, in bridges, floors and walls. Of special interest is the reinforced girder and beam shown in the illustration. The spiral reinforcement has increased the resistance of the girder by a considerable amount.

In special tests a freely supported beam was reinforced in the tensile zone by six longitudinal rods of 30 mm. (1.2 in.) diameter. In the compressive zone the reinforcement consisted of two interlinked spirals of 7 mm. (0.3 in.) steel wire. The diameter of the spiral core was 150 mm. (6 in.) and the pitch of the spirals varied between 20-30 mm. (0.8-1.2 in). Ten 6 mm. (0.2 in.) steel rods ran through the center of the spiral in a longitudinal direction. The concrete was mixed 350 kg. (770 lb.) cement to 1,200 litres (36 cu. ft.) sand. When rested the beams could not be broken by a pressure of 102,000 kg. (224,400 lb.), and the tests had to be interrupted, as the beams bent and the reinforcement stretched in the tensile area. The outside layer of the concrete covering the spirals cracked and fell off during the tests. Computations showed that the cross-section of the beams, 182 sq. cm. (29 sq. in.) resisted a load equal to 560 kg. sq. cm. (7,952 lb. sq. in.). It would be impossible to obtain such a tremendous strength with the ordinary stirrup reinforcement without increasing the cross-section of the beam or column considerably.—*Umschnürter Beton.*



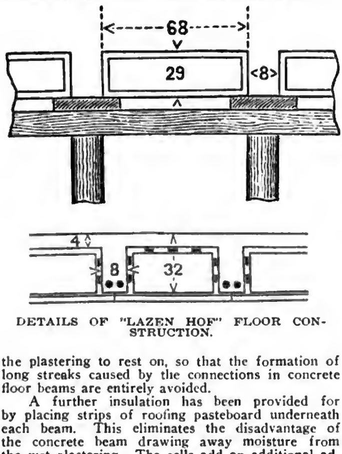
BEAM AND COLUMN DETAILS SHOWING USE OF SPIRALS TO RESIST COMPRESSIVE STRESSES.

Iron Filings for Cement Floor Finishes

Iron filings and scraps mixed with mortar for cement floor finishes in stables and halls to make the floors less slippery have been used in quite a few cases. Some claim that iron filings added to the cement will increase the durability and strength of the floor, while others deny this and say that they merely make the surface rougher and prevent the floor from becoming slippery by long use. One of the arguments against this system is the fact that the wear and tear is not equally strong on all the parts of the surface and that, as a result, the sharp points and rough edges of the filings penetrate at some points and lead to injury. As regards the matter of slippery floors, it seems hardly necessary to have recourse to iron filings to prevent slipping, for cement floors give as a rule no reason for complaint in this direction. The filings which are subject to the action of rust give the floor moreover a dirty, ungainly appearance, and prevent its use in living rooms, though perhaps suitable enough for stables. Several German firms have constructed floors for stables and riding schools, using iron filings or else pulverized iron in the proportions ½ part filings to 1 part Portland cement to 1½ parts sand, the floor finish being 2 cm. (0.8 in.) thick.—*Zement und Beton.*

New Floor Construction

Some time ago "Lazenhof," an old building in Vienna, dating back several centuries, had to be remodeled and in the new construction the floor system is of interest. The floors are of the so-called "cell-floor" type. These cell-floors consist of monolithic poured reinforced concrete floors, with 8-12 cm. (3.2-4.8 in.) wide ribs and a distance of 75 cm. (30 in) between ribs, with a height of 25 cm. (10 in) for the ground floor and 32 cm. (12.8 in.) for the other floors. The slab is 4 cm. (1.6 in.) thick, reinforced by 10-5 mm. (0.2 in.) steel rods. The hollow spaces in the slab beams are formed by cells. These consist of rectangular wooden frames upon which the "Bacula-web" is nailed. This "Bacula" web is a network of 6-10 mm. (0.2-0.4 in.) square wooden rods which are interwoven with similar wooden rods making meshes of 5 mm. (.2 in.) width, which are interwoven with wire to form a sort of mat. These mats are nailed upon the side ana upper parts of the frames, while a wide meshed web is nailed to the bottom of the frames and in this way an even continuous surface is left for



DETAILS OF "LAZEN HOF" FLOOR CONSTRUCTION.

the plastering to rest on, so that the formation of long streaks caused by the connections in concrete floor beams are entirely avoided.

A further insulation has been provided for by placing strips of roofing pasteboard underneath each beam. This eliminates the disadvantage of the concrete beam drawing away moisture from the wet plastering. The cells add an additional advantage, in that the falsework props or posts need only be placed where there will be a beam, and the cell is freely supported between the two adjoining posts. The greatest gain is, however, in the small weight of the floor, which is only 200 kg. m² (40 lb. sq. ft.) The reinforcement is arranged so that two steel rods are sufficient for one girder, and stirrups need only be used in girders which support a wall.—*Beton und Eisen.*

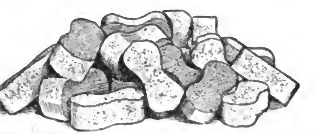
Fireproof Qualities of Concrete

A large drygoods house in Dresden caught on fire in August, and the fire gained such proportions, as to require three alarms. The entire skeleton work of the building, as also the floors were built of reinforced concrete. In spite of the fierceness of the fire, the fire department succeeded in keeping the fire within the second floor where it had originated. This success was due entirely to the concrete construction. Subsequent examination of the building showed that the concrete floor had not taken any harm at all, although exposed to a heat close to 1100°C. Only in a few places at intersections of beams had the concrete fallen off and laid bare the steel reinforcement, without, however, loosening the same. The linoleum flooring had blistered through the heat, but the concrete layer below that had stood the test and had also prevented water from soaking through and injuring the floor below. The cement finish on the walls had peeled off, but the walls had not been injured. The result of this severe test is very satisfactory for the fireproofness of concrete, and shows that it stands second to none among building materials in this regard.—*Zement u. Beton.*

The Influence of Transportation on Concrete

While French practice in concrete construction is to convey the raw material to the building under construction and there set up a contractor's plant and make the concrete as needed, some German practice has been to finish the concrete at the plant and then convey it to the building, often over long distances. The French do not favor this latter practice as they fear the action of the vibrations and shaking to which the concrete is exposed in transportation, and also do not care to meet the expenses of transport and delays due to unfavorable weather, which is especially common in the winter.

Herr Magens, a German engineer, has investigated this question and has made comparative tests between concrete cubes made at the plant and then conveyed longer distances to the buildings, and between concrete cubes made directly at the building and then used there. He recommends the use of slow setting cements, as also a long setting time in warm weather if possible. If the cement has set a sufficiently long time, the vibrations of the transportation will have no bad effect on the concrete. In comparing test cubes, he allowed them to set 28-60 days and then tested them, finding that the concrete conveyed long distances showed in nearly all cases a considerable increase in compressive strength, varying between 4 to 48 kg. sq. cm. (56-198 lb. sq. in.). A number of laboratories that were interested in this question made similar experiments and found the same results, the variations being from 7 to 33 per cent in favor of the transported concrete. In general it may be said that transportation of concrete has no bad effect on the same, and in many cases has even a good effect. The results also point to the conclusion that inert material with sharp and ragged edges such as broken stone gives better results than smooth round material like pebbles and gravel. It is claimed that the shaking and the vibrations to which the concrete is subjected in conveying even adds to its density and closer structure. The building department at Ratzeburg tested transported concrete for foundations and found it to be 15 per cent superior to the concrete made at the construction plant. This concrete had been transported a distance of 5.000 ft. from the place of manufacture to the building where it was to be used, the conveyance being by industrial railway and conveyors.—*Le Ciment.*



BRIQUETTES

MONTHLY COMPARATIVE TABLE

Imports of Portland, Roman and Hydraulic Cements.

Country	Month of Oct., 1910 Barrels	Month of Oct., 1910 Value	Month of Oct., 1911 Barrels	Month of Oct., 1911 Value
United Kingdom	21,144	$23,594	215	$ 335
Belgium	16,533	22,414		
Germany	3,135	3,932	794	1,137
Canada	221	582	9	18
Other Countries	2,439	3,379	409	648
	43,472	$53,901	1,427	$2,138
Less Foreign Cement Exported	9,544	11,273	35	55
	33,928	$42,628	1,392	$2,083

Decrease in imports during the month of October, 1911, as compared with October, 1910 . . . . . 32,536 barrels

Country	10 Months Ending October, 1910 Barrels	10 Months Ending October, 1910 Value	10 Months Ending October, 1911 Barrels	10 Months Ending October, 1911 Value
United Kingdom	26,365	$ 29,894	1,807	$ 2,587
Belgium	98,889	130,945	8,571	10,396
Germany	83,463	119,524	112,758	181,967
Canada	6,116	8,869	1,000	1,940
Other Countries	20,856	29,609	10,225	15,485
	235,689	$318,841	134,361	$212,375
Less Foreign Cement Exported	16,269	23,020	8,134	13,525
	219,420	$295,821	126,227	$198,850

Decrease in imports during 10 mos. ending October, 1911, over 10 mos. ending October, 1910 . . . 93,193 barrels

Imports of Portland Cement into the U. S. during October, 1911 by Districts

District	Barrels	Value
Boston	131	$ 210
New York	878	1,262
New Orleans	409	648
Cape Vincent	5	8
Minnesota	4	10
	1,427	$2,138

Exports of Cement

Exports of cement, month of Oct., 1910—261,406 bbls., value $381,176
Exports of cement, month of Oct., 1911—256,304 bbls., value $398,529
Decrease in exports, month of October, 1911, over month of October, 1910 . . . . 5,102 barrels
Exports of cement, 10 mos. ending Oct., 1910, 2,075,331 bbls., value $2,915,924
Exports of cement, 10 mos. ending Oct., 1911, 2,652,071 bbls., value $3,924,467
Increase in exports during 10 mos. ending October, 1911, over 10 mos. ending October, 1910 . . 576,740 barrels

Missouri Cement Statistics

In a bulletin issued by the State bureau of labor statistics on the cement industry of Missouri, Commissioner Austin W. Biggs, shows that in 1910, the State ranked fifth in the number of barrels of this useful commodity produced, as well as in the value of the same, while in 1909 the State held sixth place.

No new plants were put into operation in the State in 1910, although one large mill began business in Cape Girardeau county during the present year while at least one other plant is in the prospective stage, so it is confidently expected that if the ratio of gain of 1910 over 1909 is kept up, Missouri will rank fourth among the States in the production of this commodity in 1911.

The four plants which operated in 1910 produced 4,465,135 bbls., valued at $3,858,088, as against a total output of 3,412,160 bbls., valued at $2,808,916 in 1909, a gain of more than a million barrels, which was worth $1,049,172 more than the 1909 output.

Despite this increased consumption at home there comes a warning cry from certain manufacturers in the State against a further production, it being claimed that the many new mills now being established will mean a production far in excess of the consumption, with a consequent loss to the individual companies.

Cement, Clay and Stone

The U. S. Geological Survey in a bulletin relating to clay and stone production states that the products of the clay-working industries in the United States—brick, tile, pottery, etc.—reached in 1910 the largest value ever attained, the total being $170,115,974, compared with $166,321,213, in 1909. Concerning stone the value of the production of the quarries of the United States during 1910 was the largest in the history of the industry and was more than double that of 1900, the figures being respectively $76,520,584 and $36,970,777.

The value of the clay products increased 54 per cent in 10 years. The stone industry, comparing 1909 with 1910, increased 7 per cent in value. It is interesting to compare these figures with cement statistics. Compared with clay the Portland cement industry in the past 10 years has increased 750 per cent. Compared with stone the increase in cement represents about 30 per cent. In the case of both brick and cement, however, prices have declined as output has increased. The use of cement has been of advantage to the stone industry. For use in making concrete the production of crushed stone in 1909 and 1910 was 11,001,611 tons (value, $7,011,150) and 13,967,940 tons (value, $8,957,098), respectively.

Tests of Material for Federal Buildings

The Geological Survey formerly made field and laboratory studies of many kinds of sands and gravels in localities where Federal buildings were in course of construction. These studies have shown great variations in the quality of sand and gravel used at different places for making concrete. Some contractors contend that run-of-bank sand and gravel are the best for making concrete, but this contention is generally not sustained by practical trials and experiments. The most desirable material is that which is free from clay, loam, or dust. Mica, pyrite, or limonite also is objectionable, if present in large quantity. A coating of dust on gravel prevents its proper contact with cement, so that such pebbles are easily broken out of the concrete.

CHIMNEY DETAIL IN CONCRETE.

A PLEA FOR CONCRETE

William L. Price of Price & McLanahan, architects, Philadelphia, believes, to quote his own words, that "living men build in architecture living ideals; dead men, in the name of culture, paw over the scrap heaps of the past." With this as his text, Mr. Price, in *The Brickbuilder,* for September, contributes a most interesting article entitled "Decorative Treatment of Plaster Walls." In this connection he states that there is no modern method of construction so fertile in its suggestiveness as reinforced concrete and hollow tile, which recalls the fact that Mr. Price was the architect for the Marlborough-Blenheim hotel, Atlantic City, which is reinforced concrete cage construction filled in which hollow tile and with floors of concrete and hollow tile. This building is shown in the article, and likewise the Reed Building, Philadelphia, and the concrete lamp posts at the Hotel Traymore, Atlantic City, all of which have been the subject of articles in Cement Age. In each concrete was a most important factor, and Mr. Price tells how it may be used in an original way and decorated with simple designs in Moravian tiles, which bear the impress of hand labor. The article should be quite as suggestive and instructive to the prospective builder of a house as to the architect, as original and economic methods of decoration are discussed. The accompanying illustrations are taken from *The Brickbuilder* as examples of the combined use of plaster and tiles, but which could be adapted with equal facility for concrete surfaces.

Dry Rot in Slow-Burning Factory Building

Under the above title, this problem is discussed editorially as follows in a recent issue of the *Engineering News.*

Notwithstanding the rapid growth in favor ot reinforced concrete as a material for factory buildings, a great many factories of "slow-burning" construction with wooden columns and beams are still being erected. The use of wood in construction has in fact been rather stimulated during the past two or three years, by some reduction in market prices of lumber. Those who have to do with the actual work of construction, however, are aware that the quality of lumber obtainable today is not at all the equal of what was obtainable fifteen or twenty years ago. The engineer or the architect may write ever so strict a specification for the timber to be used in columns and beams, but he has to accept what can actually be obtained under the commercial conditions of the market.

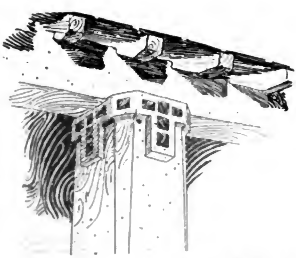
Investigation in a Canadian cotton mill of slow-burning construction where serious deterioration from dry rot occurred within four years of the mill's completion, showed that the beams attacked by dry rot were in almost every case not long-leafed Georgia pine at all, as specified by the architect in the original construction, but Cuban or loblolly pine.

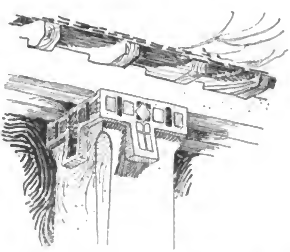
Such occurrences as this bring definitely home to the engineer that the long-predicted exhaustion of the timber supply is no longer in the future but in the present.

Timber is still obtainable in the market, but it is of a quality very different from that which was formerly available, and is too often lacking in reliability.

Ornamental Concrete Posts in California

A new venture in municipal lighting is being made by Venice, Cal., with a concrete ornamental post, designed by City Engineer Lewis. The city will manufacture them to sell to property owners at cost and furnish light free of direct charge. Molds made to order have been procured by the city and all preparations for producing the standards in municipal yards are complete. The post itself will cost \$9. The total expense of setting up the concrete post, equipping it with electric light and connecting with conduit is placed at \$15 each.





DETAILS OF CAPITALS INLAID WITH TILE.

CONVENTION AND EXHIBITION NOTES

EACH year sees an increasing number of gatherings, conventions and exhibitions to study the year's developments in cement and concrete. The effective and economical use of this material demands careful study and attention and investigation of what the past year has brought forth. For information and reference, the following list of organizations are of interest:

NATIONAL ASSOCIATION OF CEMENT USERS, Harrison Building, Philadelphia, Pa., Richard L. Humphrey, Philadelphia, President.

The convention this year will probably be held at the Kansas City Cement Show, March 14-21. The association has done much to advance the proper use of cement; the specifications formulated have raised the standard of work; the papers and discussions, at the annual conventions, assist the members in solving the problems in their daily work. The leading men of the industry, engineers, architects, contractors, concrete specialists and artisans in all parts of this country consider such membership worth many times the small annual dues of $5, and membership in the association has now reached a total of over 1,100 active live men.

It is universally acknowledged that the increased usefulness of this association will have an important bearing on the future of the industry, and it is believed that the information the members receive through the efficiency resulting from an increased membership will be such that no one interested in the industry can afford not to be a member.

CEMENT PRODUCTS EXHIBITION CO., Commercial National Bank Building, Chicago, Ill., J. P. Beck, Gen'l. Mgr.

As previously announced in CEMENT AGE three Cement Shows will be held. They are:

THE SECOND NEW YORK CEMENT SHOW, Madison Square Garden, January 29 to February 3, 1912.
THE FIFTH ANNUAL CHICAGO CEMENT SHOW, Coliseum, February 21 to February 28, 1912.
KANSAS CITY CEMENT SHOW, Kansas City, Mo., Convention Hall, March 14 to March 21, 1912.

NEBRASKA CEMENT USERS' ASSOCIATION, York, Neb., Peter Palmer, Oakland, Neb., Secretary-Treasurer.

The Mid-West Cement Exposition will be held Feb. 5 to 10, at Omaha.

The management is assured of a very fine exhibit of cement products and all lines of allied machinery. During the show the association will hold its annual meeting, and much of interest to the trade will develop during the sessions.

NORTHWESTERN CEMENT PRODUCTS ASSOCIATION, 410 Pioneer Press Building, St. Paul, Minn., J. C. Van Doorn, Security Bank Building, Minneapolis, Secretary.

IOWA ASSOCIATION OF CEMENT USERS, Ira A. Williams, Ames, Ia., Secretary.

As announced in the November issue of CEMENT AGE, this association will hold this winter's convention and cement show at Sioux City, January 10-12. This is the eighth consecutive convention and show of the Iowa Association, and each year's event has shown such a growth over the ones past that only the largest cities can now accommodate it.

CONCRETE MACHINERY MANUFACTURERS' ASSOCIATION, Le Roy A. Kling, Secretary, Cedar Rapids, Ia.

OKLAHOMA CEMENT USERS' AND CONTRACTORS ASSOCIATION, D. C. Patterson, 330 Bassett Building, Oklahoma City, Okla., Secretary.

INTERSTATE CEMENT TILE MANUFACTURERS ASSOCIATION, Estherville, Ia., L. L. Bigham, Estherville, President; Charles E. Sims, Worthington, Minn., Secretary.

CANADIAN CEMENT AND CONCRETE ASSOCIATION, Wm. Snaith, 57 Adelaide St., Toronto, Ont., Secretary.

Combining Pleasure and Profit at the Cement Shows

Madison Square Garden is about to be torn down. It is a masterpiece of a master architect, Stanford White, yet at the close of the second annual New York Cement Show on February 3, it will pass into history. The New York Cement Show gives the visitor a last opportunity of studying this historic hall.

The Cement Show of last year opened the eyes of New Yorkers to the fact that the giant strides of concrete construction offered something of interest, not only to engineers, architects, contractors and builders, but make a broader appeal to property owners, home builders, and factory managers,—in fact, to all who live and work within walls, and whose business success is dependent on the highest development of building construction, the elimination of fire losses with attendant stoppage of business, and the utilization of the most modern appliances and fittings of building constructors.

Decoration of "The Garden" will be complete. The ceiling decorations and the hiding of all unattractive construction features of the large hall, have been given careful thought and every effort has been made to turn "The Garden" first into an attractive place for the pleasure seeker and into exceptionally well planned room for the display and study of the 200 separate exhibits.

An exceptionally strong line of exhibits is expected. This has been a good year with most of the construction companies. They are looking forward to an even greater volume of business for 1912. The Cement Shows are their greatest lever for forwarding concrete construction. Knowing this, no expense will be spared by exhibitors to present their products in a practical way for close study, as well as in an artistic way to make the hall not a rough contractor's plant but a garden both practical and artistic.

Special interest will be manifested this year on the part of architects, who will find in the gallery a representative collection of designs and drawings showing the best of concrete design in office buildings, factories and homes. This feature was considered one of the most valuable at the Chicago Show last year. It is planned to bring together an equal or better collection of drawings, work by the greatest architects in the greatest city of the United States.

A special appeal is made this year to building supply dealers, those handling lumber, lime, cement and building appliances needed in modern rein-

forced concrete construction. Careful study of the exhibits at a trade exhibition such as this should put the supply dealer in possession of such facts of construction, and such helpful ideas as to contractors' plant equipment, engineering designs and labor saving devices and building accessories, as will make him of distinct help to his trade. He may institute himself as a "Service Bureau," a "clearing house" for the co-ordination of the ideas of the designer, builder and owner. Dealers unconsciously do this in some measure, and such constructive help should strengthen trade, should clinch sales with occasional customers, and make them a force for better and more economical building in their home fields

The contractor can buy equipment in two ways: he may go from salesroom to salesroom, or from catalog to catalog, taking the word of the advertising writer, or carrying in his mind the relative advantages of competing machines as he studies each company's product. It is difficult to make a choice under these conditions. Or he may visit the cement shows, see competing machines side by side, study their relative merits in a way that it is impossible under the usual buying plan. Manufacturers from scattered cities such as Cleveland, Chicago, Philadelphia and Pittsburg, as well as New York, will all show within a radius of a few feet. For the careful buyer the cement show offers the one good opportunity of the year.

The New York Show is the first of three to be held this year. Chicago will have its fifth, and Kansas City its first Cement Show. Do not fail to attend at least one of these gatherings.

Loans on Concrete Buildings

With Portland cement at 65 cts. a barrel progress of reinforced cement construction will receive an added impetus, says the Bulletin of the Real Estate Board of Brokers. At present it costs about one-half the price of brick construction in large work, and there is no economic reason why it should not supplant brick.

It also says there is a disposition on the part of some mortgage loaners to look with disparagement on this new type of building, but large loaners of money have assured brokers they would have no objection to loaning on concrete structures provided the buildings were constructed by competent builders, that being the one point to safeguard in concrete work of any kind; otherwise they regard them on the same basis.

It adds: If a building (concrete) costing 10 cts. a foot competes on an average basis of income with one (brick) costing 18 cts. to 20 cts. a cubic foot, how long can a borrower continue to procure an adequate loan on the brick structure? Apparently the mortgage loaner should favor concrete as giving him a security having a decided economic advantage over brick, or he may have to cut down his loan on the brick structure as it becomes more economically inefficient.

Indiana Engineering Society.—The next annual meeting of the Indiana Engineering Society will be held at the Denison Hotel, Indianapolis, January 25-26-27, commencing at 2 p. m., Thursday evening the 25th. The annual banquet will be held on the evening of January 26th. In connection with the convention there will be an exhibit of articles or products of engineering interest. Exhibitors can procure space at regular hotel rates by applying to the secretary, Chas. Brossman, Union Trust Bldg., Indianapolis, Ind.

NEW BOOKS LISTED

CEMENT PIPE AND TILE, (Second Edition), by E. S. Hanson. Published by Cement Era Publishing Co., 1207 Morton Bldg., Chicago, Ill. 5 x 7½ in., cloth bound, 151 pages. Illustrated. Price $1.00.

LECTURES ON REINFORCED CONCRETE, by Professor William Dunn. Published for the University of London Press, by Hodder & Stoughton, Warwick Square, E. C. England. 5½ x 8½ in., cloth bound, 141 pages. Illustrated. Price $1.50 net.

HANDBOOK FOR ARCHITECTS & BUILDERS, published under the auspices of the Chicago Architects' Business Association, Vol. XIV, 1911. 9¼ x 6 ins., leather bound, 360 pages. Illustrated.

SAXTON'S LOGS, by E. Saxton, published by the author, New York, table and text, leather bound. Price $2.00.

THE STANDARD DOCUMENTS OF THE AMERICAN INSTITUTE OF ARCHITECTS, American Institute of Architects, Washington, D. C. 11 x 8½ ins., paper bound, 11 pages.

REINFORCED CONCRETE DESIGN SIMPLIFIED, by J. C. Gammon. Published by Crosby Lockwood & Son, London, W. C. 9 x 11 inches, cloth bound, 116 pages. Illustrated. Price $2.50.

REINFORCED CONCRETE CONSTRUCTION, by Henry Adams and Ernest R. Matthews. Published by Longsman, Green & Co., London, New York, Bombay and Calcutta. 6 x 9 in., cloth bound, 316 pages. Illustrated. Price $3.00 net.

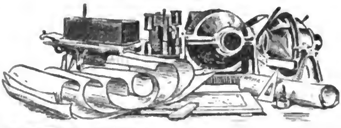
THE CONCRETE INSTITUTE, Transactions and Notes, Volume III. Published at the offices of the Concrete Institute, Denison House, 296 Vauxhall Bridge Road, Westminster, England. 5½ x 8½ in., paper bound, 328 pages. Illustrated.

REINFORCED CONCRETE PATENTS, Their Scope or Monopoly Value. Charles J. Williamson, LL. B., LL. M., McLachlen Building, 700 10th street, Washington, D. C. 9 x 6 ins., paper bound, 14 pages. Illustrated.

THE STONE INDUSTRY IN 1910, Ernest F. Burchard, Washington, D. C. 9 x 6 ins., paper bound, 42 pages.

THE ROYAL INSTITUTE OF BRITISH ARCHITECTS, CALENDAR, 1911-1912. Seventy-seventh Session, November, 1911, October, 1912. London, Conduit street, Hanover square, W. 571 pages, 8½ x 5½ ins., paper bound.

Monks and Johnson, architects and engineers, 7 Water street, Boston, have associated themselves with Henry F. Keyes, architect, 161 Devonshire street, Boston, for the preparation of plans and specifications for certain large industrial developments.



PATENTS

In order to keep the readers of CEMENT AGE *in touch with the progress that is being made along the lines of invention in the cement industry of the United States, a list of patents granted by this Government will be published monthly. No attempt shall be made to describe any patent in detail or to publish any diagrams in this department; patents that cover vital points will be treated in the regular editorial columns if their importance warrants. Rather it is the purpose of this list to keep the reader posted in the principal inventions that are of interest and value; detailed information will be furnished on request to* CEMENT AGE.

Illustrations and specifications of any of the patents mentioned in this department will be forwarded on receipt of 25 cts. to cover costs. Address Royal E. Burnham, 857 Bond Building, Washington, D. C.

1,009,037. Hoist for concrete and the like. Charles E. Bathrick, Chicago, Ill., assignor to Frederick C. Austin, same place.

1,009,038. Hoist for concrete and like material. Charles E. Bathrick, Chicago, Ill., assignor to Frederick C. Austin, same place.

1,009,117. Apparatus for the distribution of concrete or the like. Frank E. Walters, Toledo, Ohio.

1,009,312. Lining wall for shafts. George W. Jackson, Chicago, Ill.

1,009,319. Building block. Henry N. King, Adrian, Mich., assignor of one-half to Franklin D. Teachout, same place.

1,009,441. Wall construction. Frank McMurray Sawyer, Los Angeles, Cal.

1,009,487. Holder for anchoring staples to cement posts. Orpheus K. Dill, Cambridge City, Ind.

1,009,528. Apparatus for manufacturing cementitious cylinderical articles. Samuel G. Kennedy, East McKeesport, Pa., assignor of one-half to William T. Pierce, Pittsburgh, Pa.

1,009,557. Apparatus for curing cementitious material. Albert A. Pauly, Youngstown, Ohio.

1,009,676. Arch, vault, conduits, etc. Daniel B. Luten, La Fayette, Ind.

1,009,712. Concrete structure. Robert Anderson, Cincinnati, Ohio.

1,009,754. Wall construction. Frederick E. Kling, Youngstown, Ohio.

1,009,840. Reinforced metal flanged concrete pipe. Joseph Hickson, Mount Gilead, Ohio.

1,009,848. Tunnel form. Charles D. McArthur, Pittsburg, Pa., assignor to Blaw Collapsible Steel Centering Company, same place.

1,010,073. Tie and rail fastener. Ross Ream, Johnstown, Pa.

1,010,131. Dam construction. Walter S. Edge, New York, N. Y.

1,010,250. Manufacture of reinforced concrete beams. Andrea Ghira, Triest, Austria-Hungary.

1,010,254. Dam. John Francis Greathead, Rome, N. Y.

1,010,316. Composite railway tie. John J. Quinn, Denver, Colo.

1,010,399. Reinforced concrete railway tie. Jesse F. A. Ault, Cambridge, Ohio.

1,010,408. Metal structure. Albert J. Bates, Chicago, Ill.

1,010,417. Sidewalk construction. Charles A. Farnum, Philadelphia, Pa.

1,010,521. Fence post. Franklin M. Reed, Indianapolis, Ind., assignor to The Inity Mfg. Co., Indianapolis, Ind.

1,010,602. Dam construction. Charles F. Doebler, New York, N. Y., assignor to National Hydraulic Construction Company.

1,010,642. System of under water foundations for great depths. Eugene Knorre, St. Petersburg, Russia.

1,010,735. Dam construction. Charles F. Doebler, New York, N. Y., assignor to National Hydraulic Construction Company.

1,010,736. Dam construction. Charles F. Doebler, New York, N. Y., assignor to National Hydraulic Company.

1,010,821. Mold for burial-cases. Gilbert Turner, Falconer, N. Y.

1,011,064. Railroad tie. Francis Klinger and William Ratallick, Williamstown, Pa.

1,011,104. Method of forming metal structures. Albert J. Bates, Chicago, Ill.

1,011,195. Building construction. Owen K. Harry, Dallas, Tex.

1,011,274. Iron or nosing for concrete work. Evert W. Thompson, Niles, Mich.

1,011,283. Building block. Howard A. Ullrich, Chicago, Ill.

1,011,335. Tie. Joseph D. Flaig, Brooklyn, Iowa.

1,011,585. Metallic reinforcement for walls. Walter L. Collins, Milford, Mass.

1,011,753. Cement block construction. John M. Crocker and Frank Tappan, Coldwater, Mich.

1,011,804. Process of burning lime. John G. Jones, Carthage, N. Y.

Concrete in Toronto Filtration Plant

[*From Municipal Engineering.*]

The filtration plant which is just being completed at Center Island, Toronto, affords a typical example of the use of concrete in this type of construction. It is possible to conceive that the tremendous strides which have been made in the methods of purifying the water of municipalities would not have taken place if such a material as concrete had not been available. An idea as to the extent of the use of concrete may be obtained by noting that the plant is constructed practically entirely of concrete, covers more than 12 acres, and to date more than 45,000 cu. yds. have been placed.

ARTISTIC CONCRETE SURFACE COLORING

While concrete houses were still a novelty architects relied upon the texture and tone of the cement itself for esthetic effects, aided by the use of much outside timbering to add to the picturesque qualities. This situation has gradually changed as concrete buildings have become numerous. The timbering has almost disappeared except for cornices, brackets, and other natural trimmings, and variation in tone and texture has been forced upon architects and others as a means of giving distinction to the different architectural beauties and relieving the monotony produced by rows of uncolored houses.

The old argument that cement surfaces do not require painting has been damaged by the general recognition of the necessity for waterproofing cement exteriors, especially of stucco houses, and architects and owners have therefore found that since they must figure upon the cost of waterproofing they could get their coloring effects at the same time, killing two birds with one stone, and giving vastly greater scope to the artistic beauties of cement construction than was possible under the old one-tone practice.

STUCCO STAINED RESIDENCE OF W. M. KENYON, ARCHITECT, MINNEAPOLIS.

The development of the coloring has passed through the usual stages common to every new art. Mixing color with cement was first tried, but this has the very apparent drawback of adding to the stucco or concrete a foreign material, and sometimes in such large amounts as to sensibly weaken the bond. The futility of using very heavy compounds, which entirely coat over the surface and practically completely destroy the naturally artistic texture of the cement itself has been demonstrated by experience to everybody of real artistic sense. In this respect the problem is very similar to that of the decoration of woodwork, and the coloring method which gives soft, rich tones without killing the natural beauty of the surface is the only method which can permanently satisfy discriminating persons. There is no more comparison between the beauty of such a coloring effect and that of a solid, opaque coating than there is between the beauty of the natural complexion of sweet sixteen and the enameled complexion of saccharine fifty. True art abhors smooth, unvarying monotony of surface, whether glossy or dull, and no one with an artistic eye will contemplate producing a nice soft texture on the surface of a cement building and then mopping it out under an opaque and beauty-killing coating.

Artistic coloring effects on cement surfaces can only be produced by saving the picturesque texture of the cement itself and tinting it in soft and rich tones like the effects of stains on woodwork. These are the tones that the waterproofing cement stains produce and like the shingle stains of which they are the legitimate successors, they furnish the esthetic beauty at lower cost and with greater ease of application and at the same time they waterproof the surface.

RESIDENCE AT STAFFORD SPRINGS, CONN., STUCCO STAINED. C. A. TINKER, ARCHITECT, WESTFIELD, MASS.

The work that Samuel Cabot Inc., of Boston, to whom we are indebted for these notes and illustrations, have done in this field is of interest, and the experience gained in developing shingle and other stains, has been applied to the problem of staining and waterproofing concrete surfaces.

A Test of Watertightness of Concrete Tunnel Lining Under High Head

C. Raymond Hulsart, Assoc. M. Am. Soc. C. E., and assistant engineer, board of water supply, City of New York, says in *Engineering News* that a recent test in the Wallkill Pressure Tunnel of the Catskill Aqueduct, on the new water-supply for New York City, showed the practicability of making concrete construction watertight against high heads. The test was made upon the concrete lining of the tunnel, which is being constructed of a nominal 1.2.4 concrete without the use of any waterproofing material.

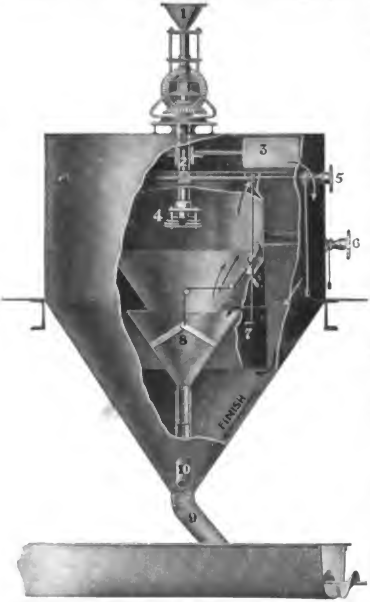
The concrete lining, constructed in circular section, is designed as an arch to withstand the maximum ground-water head when the tunnel is empty and to prevent leakage into the tunnel when empty or outward when in service. The construction of the tunnel is described in detail and illustrated with profile and sectional drawings and photographs of completed work. The author presents the following important conclusions:

It may be safely concluded that with reasonable care in mixing and placing of concrete, and with sufficient excess cement a concrete can be had which will be practically watertight against hydrostatic heads of several hundred feet. In case of tunnel lining proper, care in placing, of course, includes care in arrangement of collecting pans and weepers to carry leaking ground-water through the concrete and forms without damage to the body or finish of the concrete. Where small leaks may have been overlooked or a collecting pan fail to work, causing some slight seepage through the concrete, it would appear from the foregoing that even though the area of lining affected be considerable, the actual amount of water passing through would be small, and that such spots of seepage will grow less by silting up.

AN IMPROVED AIR SEPARATOR

The problem of fine grinding is always of interest, and the air separator, developed by George S. Emerick of Nazareth, Pa., is being used successfully by many cement plants. The accompanying illustration shows the essential features of this machine, and the operation is as follows:

The pulverized material enters the separator through hopper, *1*, is conveyed through feed pipe *2*, and deposited on the revolving discs *4*. The fine material is drawn or lifted up from the discs *4* by



PHANTOM VIEW SHOWING OPERATION OF AIR SEPARATOR.

Explanation of internal mechanism: (1) Hopper for reception of ground material. (2) Feed pipe through which material is conveyed to revolving discs. (3) Fans for creating currents of air. (4) Revolving discs. (5) Hand wheel governing adjustable damper to regulate volume of air. (6) Hand wheel governing adjustable cone for final separation, if necessary. (7) Adjustable damper. (8) Adjustable cone. (9) Outlet for finished material. (10) Outlet for tailings. (11) Inside stationary cone. The arrows show direction of air currents. Very little outside air is admitted as most of the air required is generated within the machine.

the air created by fans *3*. The internal arrangements, shape of shell and position of inside cones, are such that the air currents are deflected to the side of shell to a point below adjustable damper *7* when it takes an upward course, lifting the fine material from the discs *4* carries it toward the sides where it drops down and leaves the separator by the way of outlet *9*. The tailings or unfinished material drops from the revolving discs *4* and passes down through the inside cones *11* and leaves the separator by way of outlet *10*. If any fine material should escape separation at the discs *4* it is intercepted by the adjustable cone *8* and is carried up and deposited with the other finished product. The volume of air required for separating the powdered material of different specific gravity can be regulated by adjustable damper *7* which can be regulated by hand wheel *5*. The adjustable cone is regulated by hand wheel *6*.

Fire Test of a Concrete House

A demonstration concrete house is being poured in the village of Queens, L. I., two blocks east from the station. The visitor may witness this novel system of home building, where the first of a large group is now well under way. The work is under the personal charge of Milton Dana Morrill of Washington, D. C., the inventor of this system.

H. P. Read, president of the National Foundry Company of Brooklyn, said in a recent interview that he intends to pour many hundreds of these attractive homes at Queens Manor, one section of which will be set aside as a bungalow colony, and some twenty or thirty different styles will be built to show their great variety and artistic possibilities in the use of concrete.

These houses will be tested in a novel way to demonstrate their fireproof character. One of them will be completed in the rough and filled with combustible material and set afire and burned out to demonstrate that the greatest loss possible would be the furniture and contents of a single room. Roof gardens and sleeping porches will be among the features of the poured houses.

Reinforced concrete accident statistics will be collected in the State of Prussia, Germany, under government auspices; the Deutsche Ausschuss für Eisenbeton (German reinforced concrete committee) is to receive the statistical data. An order was issued to all the police heads of Prussia on Sept. 18, 1911, by the Minister of Public Works, directing them to co-operate with the committee "Zentralblatt der Bauverwaltung," Nov. 1, 1911. The order was accompanied by general instructions for procedure, and a list of experts who give their services to the committee as investigators. When an accident to a reinforced concrete structure comes to the notice of the police (or the building bureau, which in Prussia is part of the police administration), an expert may be chosen from this list to investigate the causes and circumstances of the accident, and in case the accident leads to judicial inquiry the public prosecutor will call for the aid of such expert. The central office of the committee is to be notified in each case, and all reports of experts will be collected there. Publication of findings will be made at the discretion of the committee. It is to be noted that the committee is a semi-official body, having been formed at the instigation of the government and occupying an office in the building of the Ministry of Public Works.—*Engineering News.*

Cement Age

A MAGAZINE DEVOTED TO THE USES of CEMENT
with which is combined

Concrete Engineering

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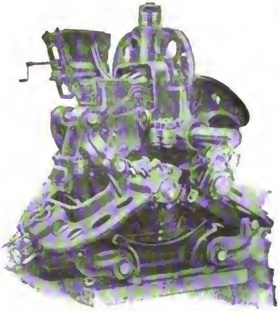

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Element of Magnesia

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Superior Endures.

Justus Collins, President — **Union Trust Building, Cincinnati, Ohio**

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WATERPROOFS AND STRENGTHENS CONCRETE

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Used on some of the largest structures with complete success. *Our booklet showing test by leading engineers is free to those interested.*

We also manufacture

HERCULES LIQUID WATERPROOFING

a colorless liquid for use on concrete surfaces such as floors, bins, cellar walls, etc.

Prevents efflorescence of brick and stone.

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Established 1907

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A MONOLITHIC CONCRETE RESIDENCE OF STATELY DESIGN.

In this work the walls are of monolithic concrete, poured between steel forms. The columns are of solid concrete poured in place. The structure is an impressive example of good concrete design and construction.

CEMENT AGE *with which is combined* CONCRETE ENGINEERING

A Monthly Magazine Devoted to the Uses of Cement and Concrete

VOL. XIV **FEBRUARY, 1912** ***No. 2***

CONCRETE IN MINES

IN a recent issue of the *Engineering and Mining Journal*, the leading editorial discusses the use of concrete in mining as an interesting development in recent mine practice. Concrete, tried at first with some hesitation, has become, in the course of a few years, a standard construction. The editorial continues:

"The factors governing the use of concrete underground, considered broadly, are probably the same everywhere; it must serve its purpose equally as well or better than material for which it is being substituted, and the cost must not be prohibitive. Considering the first of these, concrete is usually required (1) to resist pressure, or the wear and tear of underground usage or both; and (2) to create a fireproof structure. The latter is an especially desirable feature in the case of shafts. To meet these requirements, it is now being used satisfactorily for solid shaft construction, shaft lining, shaft rail stringers, timbers, etc., and in some cases for timbering lateral openings and shaft stations. It has been applied equally well to both circular and rectangular shafts.

"Considering the second factor, cost, this depends principally upon the supply of labor and material. It is believed that the labor generally available at mines can be trained without difficulty in the proper handling of concrete. The supply of material, such as suitable sand, rock, cement, etc., is probably the most important factor. That the almost unlimited and therefore cheap supply of rock, sand and reinforcing materials is largely responsible for the extensive use of concrete in the Lake Superior country, there can be little question. At the same time it is hard to understand why concrete is not more extensively used in other districts, especially since it is so widely used in surface construction. Old material such as discarded hoisting ropes, mine rails, etc., forms admirable reinforcements if carefully used, and waste rock in many cases is suitable for mixing purposes. That it is coming into more general use for such work is indicated by recent or contemplated installations in some of the Western properties, notably that of the Old Dominion where it is proposed to line a shaft with concrete for over 1,000 ft. Its especial recommendation is the proof against fire and this should go a long way toward overcoming the usual objections to initial cost, which is generally higher than for other materials."

COMPROMISE CONSTRUCTION

A REINFORCED concrete skeleton factory building with brick curtain walls and timber floors is an interesting design, and in a way a logical development out of mill construction toward straight reinforced concrete. It is mill construction in that it uses wooden floors. It is typical reinforced concrete in the wall construction, columns, and T-beams, and girders. A double timber flooring replaces the concrete slab. The comparative value of such a wearing floor is at the present time, only a matter of opinion. To meet our present day conditions, and to overcome any apparent objection to monolithic concrete, this "compromise" construction, as it were, is serving its purpose, not only in replacing heavy and expensive mill-timbers, but also in showing the wonderful adaptability of reinforced concrete to meet any structural condition. This last is an important lesson of the design.

CONCRETE ROADWAYS

SOME time ago we referred to the 23,000,000-dollar "mud tax." An interesting corollary to this is the opinion of a contemporary which we quote as follows:

The concrete road, the one in which, of course, we are most deeply interested, seems to us to offer a line of talk that is very persuasive. A country road which cannot become muddy, which will give at all times a sure footing for horses, and which will need little or no repairs, would be the greatest improvement in rural conditions that has been made in some years. Concrete seems to be the only material which can combine so many qualities at a sufficiently low cost. A decade from now, country roads of concrete are bound to be common and will rival any city pavements in efficiency under all weather conditions.

As a benefit to a general community, there can be no question of those derived from good roads. The farmer and the merchant of to-day will complain of the high freight rates charged by the railroad companies when, as a matter of fact, it costs the farmer more in most States to get his product to the railway station than it does to pay freight charges to the market. What is the cause of this? Principally poor roads. The farms of any community should be its pride. They are the foundation

of its prosperity, and prosperity continues to be the greatest factor in the betterment and progress of the country. Good country roads would, therefore, add to the farmer's profit, and, in so doing, would add to the profit of the town merchant by reason of making the territory adjacent more prosperous. Better roads will, comparatively speaking draw him nearer to town, place him in closer contact with the commercial world, resulting in more frequent buying.

Roads are the arteries of our social structure, and for civil health, our roads must be easily passable at all times. Concrete offers the ideal highway construction.

CONCRETE FURNITURE

RECENT newspaper interviews with Thomas A. Edison quoted the great inventor as saying that he could make concrete furniture cheaper and better than wood, and that such furniture would soon be on the market. Mr. Edison's attention had been drawn to this subject, the interviews said, while experimenting with concrete phonograph cabinets, which have proved very successful. Embellished in the familiar newspaper style, the interview was featured by several New York City papers and aroused comment. The cartoonists seized upon concrete furniture with whoops of joy and many amusing sketches were produced throughout the country.

If there is any objection to the publication of such articles on the part of those who are honestly striving to advance the cause of concrete, it lies in the impression created that Mr. Edison has "invented" concrete furniture and the insistence that such furniture will be "cheaper than wood." Concrete lawn and garden furniture has been manufactured in this country for many years. Much of the workmanship has been of a very high order. It is not "cheap," however, except in comparison with marble or bronze, with which it competes. A concrete bed-room set is quite within the range of possibility, but to make satisfactory smaller articles, such as chairs, would seem to be a more difficult problem. At first thought this would seem to require a design so massive that few families would care for it. Concrete is fluid stone with most of the properties of stone and may be molded into practically any shape. There is, for example, the case of a builder who took a clay impression of a window sash of small panes into which he poured cement with entire success. He estimated the cost of a large window at less than $1, whereas the same thing in wood would have cost perhaps three times that amount. The excessive weight of the cement was the only objectionable feature. For this reason it seems unlikely that manufactured stone furniture for the living rooms will ever attain great popularity. If it does, it will have to be skilfully and carefully made, and it will hardly be cheaper than wood until the price of wood has advanced far beyond present cost.

FOREIGN TRADE OPPORTUNITIES

CEMENT manufacturers and makers of cement machinery will be interested in the consular reports printed on another page of this issue. The reports deal with the situation in various foreign countries, some of them extremely remote, but in each there is manifested great interest in concrete and its value as a structural material. The development of concrete construction has reached a point where American manufacturers of concrete machinery may hope to build up a valuable trade. In some countries the manufacturer of cement might find it possible to compete with foreign makers, while in others transportation charges and tariffs are prohibitive. It will also be noted that these foreign consumers of cement have shown ingenuity in finding new uses for the material. In this connection special reference may be made to the New Zealand letter boxes and poles. A description of this economical and practical device constitutes a special article in this number. The matter of chief interest, however, is the fact that the use of Portland cement is constantly increasing in all parts of the world, and its general adoption by peoples less enterprising than the American nation shows what may be expected in this country within the next few years.

GOOD ROADS

ATTENTION is directed to the brief summary, in the January issue of the effective use of concrete in county road construction. The official report referred to is a remarkable document, and the work which it describes will long remain an example of *durable permanent road construction* at cost. The report should be in the hands of everyone interested in road construction. Following is a quotation from the introduction:

"Good Roads have a money value far beyond our ordinary conception. Bad roads constitute our greatest drawback to internal development and material progress. Good roads mean prosperous farmers; bad roads mean abandoned farms, sparsely settled country districts and congested populated cities, where the poor are destined to become poorer. Good roads mean more cultivated farms and cheaper food products for the toilers in the towns; bad roads mean poor transportation, lack of communication, high prices for the necessaries of life, the loss of untold millions of wealth, and idle workmen seeking employment. Good roads will help those who cultivate the soil and feed the multitude, and whatever aids the producers and the farmers of our country will increase our wealth and our greatness and benefit all the people."

POURED HOUSES IN HOLLAND

By George E. Small*

THE idea of building a structure of concrete as a monolith is about forty years old, as patents show, dating back as early as 1872, but probably the first practical demonstration of a house built in its entirety at one operation, was realized on May 3, 1911, when H. J. Harms, Jr.,† one of the inventors, in co-operation with H. Hana, an architect of Holland, poured a house complete in 6 hours using cast-iron molds.

The systems prior to this have been satisfied with wall construction a few feet at a time, or in extreme cases a story at a time. The accompanying photographs, taken at intervals during the progress of the work, and the plans and elevations, herewith reproduced, give an idea of what can be accomplished, although it is only a demonstration house.

Many things were proven by the building of this house:

1st. That the house is much cooler in summer than houses built of any other material, and that so far it is warmer in winter, proving that concrete is a poor conductor of heat and cold.

2nd. That the walls and floors are almost sound proof, and when it is realized that the floors and walls are only 15 c. m. (6 in.) thick, and the partitions only 10 c. m. (4 in.) thick, it can readily be seen that when made slightly thicker apartments and two-family houses are possible, which will avoid the annoyance that is occasioned by the family upstairs.

3rd. That the walls, without being waterproofed, are absolutely dry, proving that it is not necessary to have hollow walls or to use any waterproofing material to keep the walls from sweating.

4th. That the walls can be painted or papered without any previous preparation.

5th. That the system is practical in every respect, for the molds may be erected in one week and dismantled in two days, the molds remaining as good as new, the surface being chemically treated.

6th. That the system makes possible the building of structures that are superior to any other building material and from 20 per cent to 30 per cent less in cost, except wood, but wood is not classed among the better building materials, and

7th. That the cost of maintainance is reduced to a minimum and being fireproof makes insuring against fire unnecessary.

The possibilities of the system are, to the layman, beyond comprehension, for the molds, being interchangeable, make possible an unlimited variety of styles and sizes of structures with the same molds The present idea, of molds of metal for building construction, is that there would be too much monotony, but when one studies the photos here reproduced, and uses a little thought, it should not be hard to convince the most pessimistic of the absurdity of such an idea, for the molds are like building blocks one sees in every household, by simply rearranging them an entirely different structure is produced.

FIG. 1—THE COMPLETED HOUSE AT SANTPOORT, HOLLAND.

The concrete for this house was placed in one continuous six-hour pouring.

This new mode of building of reinforced concrete has an entirely new and fascinating ornamentation, quite its own, making unnecessary the addition of any superfluous adjunct.

The house is entirely of reinforced concrete, making it earthquake-proof, and the walls and floors being solid makes it impossible for rats or mice to live therein.

The system is patented in the United States and all important foreign countries and great progress is being made in some of the foreign countries toward the practical development of the system as present orders for several hundred houses show.

The construction of the house in detail was as follows: The excavations were made for the foundations after which the foundations were placed, of such a size to carry the structure, then the ground floor was laid in one slab or "matte," being reinforced so that a bed or extra thickness of base was

*Monogram Construction Co., Santpoort, Holland.

†Also of the Monogram Construction Co.

unnecessary. When the foundations had become sufficiently hard for proceeding with the work, the first course of molds, forming an inner and outer wall of cast-iron, was placed thereon and levelled, then the work of erecting the successive courses of molds proceeded to the ceiling of the first floor, at the same time the door and window frames were set, and the reinforcing for the walls placed and securely fastened. The molds, as can be seen upon observing Figs. 4 and 5, are bolted together at the flanges, the bolts being spaced approximately 12-in. on centers both vertically and horizontally.

The system provides for two ways of making the floors and steps:

(1st.) By pouring, and

(2nd.) By casting in advance and placing during the erection of the molds. The latter was chosen for this house.

The steps were erected in their proper positions resting on the molds and then the floor slabs were placed and the floor reinforcing securely fastened to the wall reinforcing making the walls and floors a unit of steel skeleton work.

The advantage of placing the steps and floors at the same time as the molds, is, that it facilitates the easy erection of the inner molds, gives easy access to the upper rooms during the complete operation, and does away with scaffolding.

FIG. 3—CONSTRUCTION VIEWS OF A POURED HOUSE.

The upper shows the steel being placed during the early stage of construction. Below is shown the first course of forms in place.

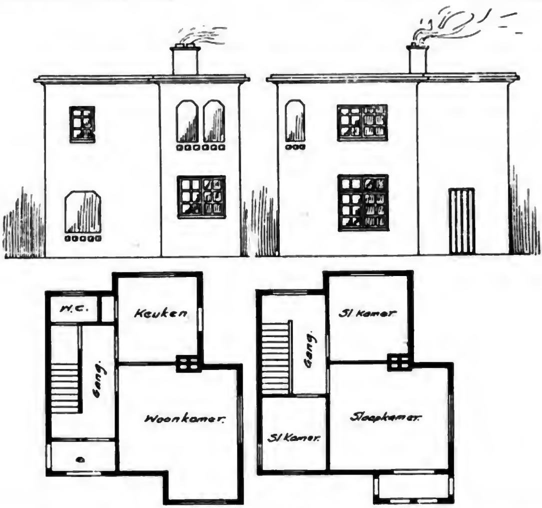

FIG. 2—FIRST AND SECOND STORY PLANT, AND ELEVATIONS OF HOUSE AT SANTPOORT, HOLLAND.

FIG. 4—PLACING A SECTION OF THE PRE-CAST FLOOR.

The floor is pre-cast in units and assembled when the forms are placed.

FIG. 7—REMOVING FORMS.

The flags are flying from the concrete tower. Undressed timber is used for scaffolding.

FIG. 5—THE FORMS ALL IN PLACE READY FOR POURING.

Note the runway to the mixer platform at the right of the building.

FIG. 6—POURING A MONOLITHIC HOUSE.

The concrete, very wet, is hoisted to the platform, and emptied into a tank, from which it pours into the forms.

After the floor slabs were placed, the process of erecting the molds was continued to the roof and the reinforcing also completed. Then the roof slabs were placed the same as the floor slabs (being cast in advance) and the chimney molds erected in place.

As soon as the molds were completely erected a tank was located above the highest point, and a chute or spout provided, leading to one of the corners.

All being in readiness the concrete was mixed at the ground level in a Smith mixer, hoisted to the tank above where it was deposited, and then flowed to all parts of the space between the two walls of cast-iron through the spout above mentioned.

The process of pouring is identical with the pouring of a casting in a foundry.

The concrete used was very fluid, so much so that it flowed on cast-iron on a 2½ per cent slope and on itself on a 1 per cent slope, showing that it is almost like water, having a tendency to seek its level.

The second day after the pouring the dismantling began and on the third day the dismantling was finished.

It was found upon removing the molds, that washing the surface immediately obliterated all evidence of joint marks. The house at Santpoort has not had the surface touched except at one or two points for experimental purposes, so the mold joints are in evidence as can be seen upon observing photograph (Fig. 1).

The roof was afterward covered with "Ruberoid,*" as demonstrated numberless times, there that seldom being a day pass as it was without some rain and often heavy storms lasting for a week at a time.

H. P. Berlage Nzn., whose name is of European renown, because of his long established leadership in modern architecture, and from whose plans the new section of Amsterdam and The Hague are to be laid out, was the aesthetical adviser for, and approved the plans of the house at Santpoort. He believes the system to be ideal for his modern and reform style of architecture, on which subject he has just completed a series of lectures in this country.

This system is suitable for building in wet as well as dry localities, hot as well as cold climates, and even where earthquakes are prevalent, in fact, there isn't any quarter of the globe where it cannot be used.

In introducing this system, known as the "MCC-System," to the public, it is the aim of the Monogram Construction Co., the owners of the patents, to place homes in reach of the struggling masses of

*Standard Paint Co., New York.

FIG. 8—INTERIOR OF THE UPSTAIRS FRONT BEDROOM.
This, as shown in the plan (Fig. 2) and the view (Fig. 1), opens out onto an upstairs porch.

FIG. 9—AN INTERIOR VIEW. THE HALL AND STAIRWAYS.

the overcrowded districts in and around large cities.

In view of the fact that there has been so much indiscriminate and indefinite information in regard to "poured houses," concrete structures poured as a monolith with one pouring, we, G. E. Small (American) and H. J. Harms, Jr. (Holland-American), the inventors of the sytem, are publishing this, the first authentic article given to any American paper, to show that the first really practical house built of reinforced concrete and poured at one time, or continuous, is the one now on exhibition at Santpoort, Holland.

Lumber for Forms

The character of the work and the lumber markets generally determine the kind of lumber to use for forms. For very nice work where exceptionally smooth surfaces are required, as in moldings and other ornamental designs, white pine is the best material to use. For ordinary work, it is too expensive and too soft to be durable where forms are used over and over again. Spruce, Norway pine, and Southern pine are generally the most available. North Carolina pine makes excellent sheathing. Spruce, in sections where it is readily obtained, is perhaps the best material for studs, joists and posts. Hemlock is too coarse grained for sheathing and is unsafe for supporting heavy framework. The hard woods are too expensive to work.—*Building Age.*

The Origin of Portland Cement

It is seldom possible to determine quite definitely who was the absolute originator of any given invention, even when the invention is comparatively modern, like that of Portland cement. Usually there are many successive steps towards perfection, and progress is assisted by a plurality of persons; and Portland cement, as we now know it, owes its perfection to the contributory suggestions of scores or hundreds of fertile brains. Recognition of this fact, however, does not greatly, if at all, discount the interest that most people take in the search for origins; the excitement being usually in the chase rather than in the capture. Apparently it is of no great practical importance to ascertain who originated Portland cement; and nevertheless it is clear that there are many who, having long supposed that Joseph Aspdin was the inventor, have had this notion disturbed by the reiterated claim that the honor belongs to Isaac Johnson (who died a few weeks ago at the age of 101), and are desirous of escaping incertitude. In another part of the present issue we print an article* that may serve either to remove or only to deepen the perplexity to which several of our correspondents have confessed; the effect depending upon individual temperament. It will be seen that Dr. Wilhelm Michaelis, the eminent chemist, having gone into the subject pretty thoroughly, does not hesitate to award the palm to Isaac Johnson. He, of course, admits the priority to Aspdin, whose patent was taken out in 1824, whereas Johnson seems not to have taken up the subject until the early 'forties. Johnson advances the claim, however, and Dr. Michaelis supports him in it, that although Aspdin got on to the track of a discovery, he, being no chemist, never evolved a satisfactory commercial product; and that Johnson, having an adequate knowledge of chemistry, was "the first manufacturer of a cement that would pass the test of the exacting engineers of British and foreign Governments." It is, apparently, a case of "honors divided"; and probably most people will be quite content to leave it at that, even though the evidence adduced may not be such as to satisfy the most rigorous and exacting demands for irrefragable proof.—*The Architects' & Builders' Journal.*

Cost Data

At the recent annual meeting of the American Society of Engineering Contractors, in discussing the question of cost data, it was brought out that contractors could not be expected generally, to divulge their costs since they usually consider this information as their personal property, or what may be called their trade secrets. Others, however, took the view that contractors are bound to benefit from interchange of ideas and publication of costs. If many of the contractors who bid on construction work, only knew more about costs there would be less ruinous bidding than there is at the present time. It has been the experience of large manufacturers that they have benefited from the publication of their costs in full detail, by the fact that competitors could see for themselves that the margin of profit was not so large as to allow great risk to be taken.

It was agreed, however, that cost-data of itself has not much value unless together with it is given full details of the method of doing the work, the character of labor, hours of work and an explanation of all conditions that would affect the cost.

*This was covered in an article under the above title in "Cement Age," December, 1911.

A REINFORCED CONCRETE HOUSE AT GWYNEDD VALLEY, PA.

By Oliver Randolph Parry*

THIS residence, now under construction for F. A. Wills, at Gwynedd Valley, Pa., by W. R. Beisel, contractor, of Hatfield, Pa., from plans and specifications of the writer, is of interest as illustrating the feasibility of concrete construction during severe winter weather, and also the adaptability of concrete to architectural treatment and the ease with which reinforced concrete may be handled by any intelligent builder under proper supervision.

The concrete work in this house was started on October 20, 1911, and one week later had reached a point level with the underside of the first floor joist. Delay in the delivery of reinforcement and the frames caused a suspension of the concrete work but did not prove as serious as would have been the case had sectional forms inside and out been contemplated, as work on the interior forms proceeded during this period. The system planned was a combination of the "sectional" and "set" forms, the interior rough forms (see Figs. 1*a* and *b* for interior and exterior face of same), being built up in advance, whilst the exterior or sectional forms (Fig. 1*c*), were inserted afterwards and raised up from time to time as the concrete was poured. Part of the building was constructed under this system but as the work progressed and the loose boards dropped in between the upright studs, the last pouring demonstrated the ease with which the forms could thus be quickly built and it was decided to adopt this method (Figs. 6, *b* to *f* inclusive) for both the interior and exterior forms.

The material for forms for basement walls was 3 in. x 8 in. and 3 in. x 4 in. hemlock uprights, set alternately every two feet and sheathed upon the inner side with 1 in. x 12 in. white pine boards and on the outside from 6 in. below cellar grade to the top of walls with the same material, using no tie rods or wires for basement walls. In the first and second stories and gables 3 in. x 4 in. and 2 in. x 4 in. were used for uprights, set about two feet on centers and doubled at all corners; the sheathing upon the inside of walls being 1 in. x 2 in. white pine boards whilst on the outside the same material was used for uprights with sheathing of 7/8 in. x 10 in. hemlock, dressed one side (see Fig. 3*a*), put up about two feet at a time as the concrete was filled in, the forms being held together with galvanized wire

FIG. 1—DETAIL VIEW SHOWING FORMS AND PLANT USED IN CONSTRUCTION OF A CONCRETE HOUSE.

View (*a*) shows the "set" forms from without the building; (*b*) shows the "set" or panel form from within the building, and (*c*) shows the batch mixer at work, and another view of the forms from the outside with one section of movable forms filled.

*Architect, Philadelphia, Pa.

tie rods made of No. 9 wire using 5/16 in. hooked bolts on the inside and outside of the forms to keep same in place.

The window and door frames were specially detailed (old Colonial plank front type) to consume the full thickness of the walls so that the forms on both sides of same might be built or slid up without cutting the forms. They also were shaped to allow a key of concrete in all cases and in addition had strips tacked to same extending into the concrete to prevent any weather leakage from without. (See Fig. 3*a*.)

The concrete was a 1:3:6 mixture for foundations and elsewhere a 1:2:4 mixture, being composed of Giant Portland cement, clean, sharp Jersey sand and fairly hard local stone of a dark blue color suggesting cement rock in its

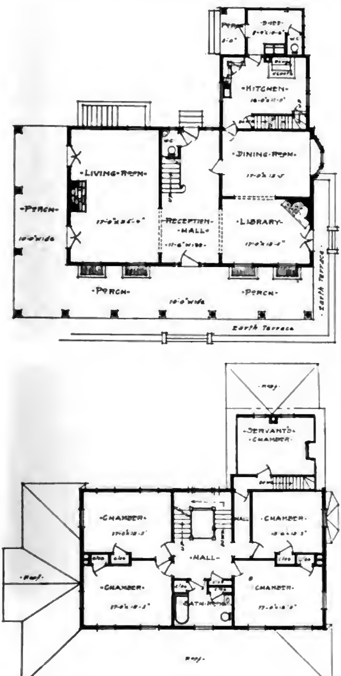

FIG. 2—PLANS OF FIRST AND SECOND FLOOR IN CONCRETE RESIDENCE.

FIG. 3—CENTERING DETAILS ON THE CONCRETE RESIDENCE.

This shows the completed first floor window frames set so forms could slide up over same. This also shows the sectional form construction. Note the bolts in the studding. The start of the loose board forms on the exterior walls is shown in (*b*).

properties. The mix was made by machine, using a Standard* batch mixer (Fig. 1*c*), but was raked over before placing in wheelbarrows.

The reinforcement, except where specially fabricated over large openings, (See Figs. 6, *b*, *d*, and *f*) was of 3/8 in. round rods, in two rows, staggered and set three feet on centers in each. (See Figs. 3*a* and 5*b*.) The same rods were used horizontally 2 ft. 6 in. on centers and fastened to the vertical reinforcement by wire clips made by the Philadelphia Steel and Wire Company. All vertical reinforcement at corners and around openings was doubled.

The work was still further delayed on account of the weather and scarcity of labor, but had

*Standard Scale and Supply Co., Chicago.

reached the bottom of the second floor joist by November 11, 1911, and a few days later the forms were removed and the front wall surface treatment completed. (See Fig. 5*b*.) The side and rear wall treatment, to this point, was completed the following day, (Fig. 5*a* and preparation made to still further hustle the concrete work, as the weather was sufficiently cold to freeze the water trickling over the forms after spading.

No preparations were employed in the mixing to counteract the cold but care was taken to keep the sand and stone covered over with tin (Figs. 6, *b* and *c*), taken from the roof of the original house which had stood upon the site. Also the cement was kept in a heated shed and in the worst weather sufficient hot water was placed in the feed barrel to take away the chill. At night and also when not pouring concrete the forms were protected by a covering of building paper and boards.

It was at about this period (See Fig. 3*b*) that the sectional forms gave way to the "loose" board forms on the exterior as well as interior, as shown above the scaffolding.

The treatment of the exterior wall surfaces, above mentioned, consisted of the application of a thin coat of cement and sand thoroughly worked with a brush and a wood float to a smooth finish, (Fig. 4) which was applied, when possible, while the walls were still wet.

An interesting feature of the concrete work was the racking over of the chimney on the gable wing. This was done to bring the chimney out of the roof in the center of the gable. It required a little ingenuity in the formation of the forms and the reinforcement, the latter carrying around the chimney and extending on both sides well into the gable walls, and horizontally on centers about two feet. (Fig. 6*a*.)

FIG. 4—SURFACING THE WALL WITH FLOAT AND BRUSH.

Fig. 6*c*. shows the completion of a gable of the house with the "loose" board forms not yet removed. As previously mentioned, the stone and sand were protected from the frost by tin (Fig. 6*b*), which also illustrates the completion of the

FIG. 5—REMOVING FORMS.

The wall in a is completed to underside of second story joists, with outside forms removed and wall floated. In b is shown the front wall surfaced to second story joists, the reinforcing rods, and nailing blocks set in concrete for the porch.

FIG. 6—PROGRESS VIEWS OF CONCRETE RESIDENCE CONSTRUCTION.

(**a**) The centering for the wing gable, and also for "racking" over the chimney to center of gable; (**b**) The concrete work completed except for one gable and the two main chimneys; (**c**) The loose board forms of gables with supporting blocks through which uprights were bolted; (**d**) Forms, completed to third story joists, note the mechanical accuracy of uprights and form boards; (**e**) The building at time of writing; (**f**) The rear of the building with the concrete work completed.

FIG. 7—DIFFERENT VIEWS SHOWING APPLICATION OF CONCRETE SURFACE COATING.

concrete work with the exception of the top of one gable and the two main chimneys. Fig. 6*b*. also shows the mixing trough with the water barrel and supply pipe to same, the water being pumped to this point from an adjacent well.

The foundation walls under the wing are used in connection with their cross walls to provide a cistern for the storage of rain water. Fig. 6*c*. illustrates the method of attaching blocks to the walls through which the bolts fastening the upright supports of the forms were run, and which provided a resting place for the loose board forms. Note one board remains in place, near the floor line, the other boards having been removed preparatory to re-use in the gable above as shown in Fig. 6*c*. This figure also illustrates the method of constructing the framework of the next story in advance of the concrete work. In Fig. 6*d* the upright supports of the forms show that mechanical accuracy of their placement and perfectly true and plumb walls are assured by this method of construction.

Fig. 7 shows the house after construction is complete. A waterproof surface coating* is being applied. Note that the ground is covered with snow.

The walls of the house are solid reinforced concrete varying in thickness from 6 in. to 8 in. and furred on the inside by wooden furring strips nailed to blocks imbedded in the concrete when pouring.

Each year shows a record of four fires to each thousand of our population.

*Made by the Glidden Varnish Co., Cleveland.

Composition Flooring in Germany

Sawdust and like waste, products heretofore regarded as useless, are now being utilized to no little extent in Germany in the manufacture of building products. Especially has a marked advance been made in the manufacture of composition flooring. One flooring of this character is made from a solution of magnesium chloride, to which pulverized magnesia and sawdust are added in proper proportions, the resultant composition on hardening possessing many of the qualities of both wood and stone. When the sawdust is omitted the combination of the other two ingredients forms a white, absolutely solid, artificial stone. Some of the floorings are mixed on the spot and laid soft on the space to be covered, while others are molded into plates and delivered ready made. Flooring of this kind varying from 23 to 25 millimeters (0.905 to 0.984 in.) thick costs 7.50 marks per square meter ($1.785 per 1.196 sq. yds.) laid. As magnesium chloride is hygroscopic, these floors may become damp if the proportions of the composition are not carefully determined upon, and the salts thereby precipitated are injurious to wood and iron. Every manufacturer has his own recipe and undertakes, naturally, to overcome this quality of the principal raw material. The cheaper grades of flooring are colored to resemble linoleum or mosaic pavements, and, in many instances, have given entire satisfaction during a considerable term of years. The emigrant halls of the Hamburg-American line at Hamburg are paved almost entirely with this composition. Under the fire test this type of flooring chars but does not burn, and is a poor conductor of heat. Manufacturers of the artificial wood plates also use cork waste as well as sawdust, and produce an infinite variety of building materials, including floorings, wainscoting and roofing plates.

Importance of Sand and Gravel in Concrete Pavements

M. D. Stoner, Civil Engineer, writes from Bemidji, a Minnesota town, to the Universal Portland Cement Company in part as follows:

"I would certainly welcome concrete pavements for all small cities or for country roads in preference to any other kind as they are cheap and far better, if properly made. I would recommend in all cases, except on steep grades, that the surface be broom-finished and not marked off in small blocks. Last year our contract price was $1.20 per yd. with gravel at $1.50 and cement at about $2.20. This year, under the new specifications, the bid was 95 cts.

"I will state, however, that unless the engineer in charge of the work has had considerable experience in concrete work and really knows good, clean gravel or sand when he sees it and in what proportions it should be mixed, a concrete pavement is just as liable to be a failure as any other kind. The quality of the sand or gravel is far more liable to be the cause of a failure than the quality of cement."

Mr. Stoner has put down considerable paving for the town and says that it is so satisfactory that the city is laying eleven or twelve blocks this year under slightly different specifications. It was an agreeable surprise to everyone to see how free from the anticipated noise it was and that it was not in the least slippery. It is in just as good condition today as when first laid.

MONOLITHIC HOUSE OF STATELY DESIGN

THERE has been to some extent, an impression that steel forms could be used only to advantage on buildings of small dimension and simple in design. A stereotypical design has been to a great extent followed in past practice, and has illustrated the great possibilities of concrete for the better houses of that type.

The frontispiece of this issue, however, shows a distinctive home. The walls and columns of this building are monolithic concrete. The walls were poured between steel forms, the "Morril" system* being used in this instance. This is an equipment using two tiers of steel plates erected by wedge connections, arranged to rotate or swing up as the wall rises, as is shown by the progress picture Fig. 2.

The building is 43 ft. x 27 ft. 6 in., contains ten rooms and bath, and is heated by hot water. One of the attractive features of the design is the loggia or sleeping porch back of columns at second story.

The walls are 12 in. for basement, and 8 in. for walls above. For horizontal reinforcement, ⅜-in. rods were put in 2 ft. o. c. Frames were built out 8 in. with 1 x 2 strips nailed on back. These frames were dropped in forms, the concrete encasing

*Read and Morrill, Brooklyn, N. Y.

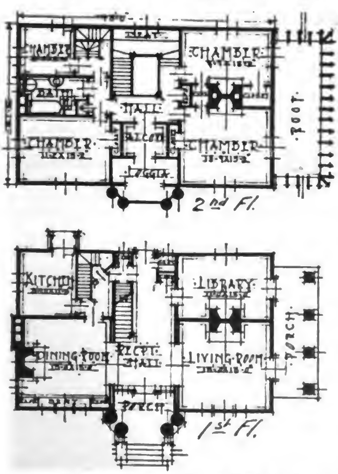

FIG. 1—FIRST AND SECOND FLOOR PLANS OF REINFORCED CONCRETE RESIDENCE.

FIG. 2—A CORNER OF THE WALL SHOWING METHOD OF "SWINGING UP" WALL FORMS.

the strip and making an air tight joint, 1 x 2 strips were set in horizontally to form nailing for furring strips. Roof is of asbestos shingles, light gray in color.

The columns are monolithic and poured in place. A form for one column was specially made according to detail by a carpenter, and one column was poured at a time.

The total cost of this house, including a few extras, was $5.500. The owner is Washington Lewis, of Braddock Heights, a suburb of Washington. Milton Dana Morril of Washington, D. C., was the architect.

On some of the best construction work, a sample of concrete is taken from the mixer once or twice a day and allow it to set out-of-doors, under the same conditions as the construction work, until the date when the forms should be removed, then, before beginning to remove, find the actual strength of the concrete by crushing the blocks in a testing machine to see whether it is strong enough to carry the dead and the construction load.

THE "CONTROL BEAM" IN THE CONSTRUCTION OF THE WAR DEPARTMENT BUILDING AT VIENNA*

THE new control beam testing system, proposed by Dr. von Emperger, and described in the November number of CEMENT AGE has received a thorough test at the construction of the new war department building at Vienna, and has proved its practical value in determining the quality and strength of concrete.

The eight story building covers an area of 103,000 sq. ft. and has a height of 30 m (100 ft.). Reinforced concrete was used for all the floor construction, the area covered by each floor being 7,000 sq. m. (74,900 sq. ft.), giving a total of 56,000 sq. m. (599,200 sq. ft.). About 40,000 sq. m. (428,000 sq. ft.) of this floor space rests on slab-beam floors of the "Porr" system, while the rest employs the plain slab panel construction. The effective load for each floor is figured at 300-1,000 kg. sq. m. (60-200 lb. sq. ft.). The span for the floor beams is 9.25 m. (30.5 ft.). A total of 8,500 cu. m. (300,000 cu. ft.) concrete and 900,000 kg. (990 tons) steel were used in the construction. The reinforced concrete work was started in July 1910, and finished in September 1911, with an interruption of three months during the winter months. Fig. 1 shows a portion of one floor where the Porr floor system was used.

One of the most important problems in connection with the reinforced concrete construction was the determination and control of the quality of materials used, and as considerable attention had been called to the Emperger "control beam," the War Department decided to give this new testing system an exhaustive trial. The Porr Construction Company lent its willing aid to this task and furnished the apparatus necessary for the tests. The concrete tests were started in November 1910. Four beams were made for each test, two with 2 per cent reinforcement and two with 4 per cent reinforcement. One each of these two pairs or series was tested after 14 days, and the second one after the coldest part of the winter had passed. Only one series of beams was tested after ten days, due to the fact that in the earlier part of the winter, and while the favorable temperature lasted, the forms were removed from the beams ten days after concreting. When, however, the nights became colder and frost set in, the War Department demanded tests before removing the forms and the "control beam" tests taken 10 days after the pouring of the concrete, showed the impossibility of form removal at that time. The compressive strength in bending at this time was found to be only 98 kg. sq. cm. (1,391.6 lb. sq. in.), reason enough to forbid the removal of the forms.

*Translated and abstracted by F. W. Scholtz from an article by J. Kromus in "Beton und Eisen."

Two of the tests with beams exposed to frost one week after concreting, gave no indications of any bad influence of the frost, although the beams had been exposed to the cold night air during all this time. Beams poured just before the frost, and some poured just after the frost also gave satisfactory results, namely 240 kg. sq. cm. (3,408 lb. sq. in.) compressive strength in bending, after 4 weeks, and 270 kg. sq. cm. (3,834 lb. sq. in.) bending strength after 6 weeks. Two other beams, on the other hand, in spite of more favorable weather conditions, gave after 4 weeks only 180 kg. sq. cm. (2,556 lb. sq. in.) and after 6 weeks 210 kg. sq. cm. (2,982 lb. sq. in.) bending strength. The reason may be that the proportion between sand and gravel was very poor, which was indicated by the low strengths and the external appearance of the beams.

Of remarkable interest are the series of beams concreted one November evening at 0°C., and exposed that same night to a 2°C. temperature, ac-

FIG. 1—CONSTRUCTION OF THE WAR DEPARTMENT BUILDING, VIENNA.

This shows the hollow wooden cores use in the "Porr" System.

companied by frost. Although both the control beam and the floor had been covered with straw, the test showed a decrease in strength to about one-half of the normal. Examination of the cross sections of the broken beams showed that both the outer layer of the concrete as also the entire structure indicated the formation of ice crystals. Fig. 2 shows the formation of these ice crystals in the concrete.

In March 1911, the work was taken up again. The experience of the previous winter had shown that only the beams with 4 per cent reinforcement need be tested and so the 2 per cent reinforced beams were not tested any further. The control tests were arranged in such a way that three test beam series

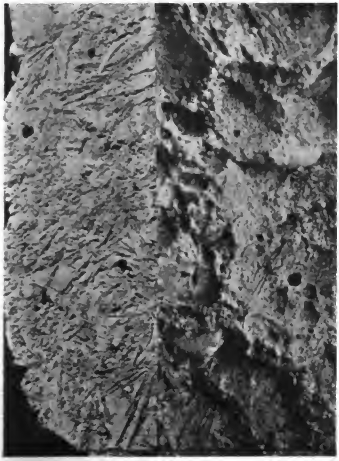

FIG. 2—SURFACES OF FROZEN CONCRETE SHOWING FORMATION OF ICE CRYSTALS.

At the left is shown an outside surface, and at right a fractured surface.

of two beams each were made, and the fourth test was made with four beams. Each fourth series was accompanied by a test cube made of the same material and at the same time. As the tests were to show not only the quality of the concrete but also the proper time for removing the forms, tests were made with one beam of each series after 14 days, followed by a test with the second beam of the series after 28 days. Of the fourth series the third beam was tested after six weeks, simultaneously with the test cube, which was tested at the Royal Testing station. The fourth beam of this last series was kept until all concrete work was finished, and again tested, thus allowing a minute control of the state of the concrete beams.

The control beam tests have illustrated the great influence exerted by the conditions to which the concrete is exposed for the first few days after pouring the forms. It has been proved that the cold weather and frost during this time result in changes, which can never be eliminated afterwards. The general opinion that cold is harmless, and only retards setting to some extent needs therefore revision. The decrease in quality is especially plain if the concrete is exposed to frost in addition to cold. Of course it should be remembered that the control beam with its small dimensions is especially sensitive to such influences, and exaggerates them somewhat. But that would speak in favor of the control beam test, as it magnifies even small defects and permits their correction.

In order to find out whether these frost phenomena appeared only in the control beams, or whether they occurred also in the floors, it was decided to drill holes into the floors at various places, and test the concrete removed by the drills. All the floors that had been poured at a low temperature, either below or above zero, and had been exposed in the following night to frost, showed the same ice crystal formation not only at the surface but through the entire thickness of concrete. Some of the floors, which had been started early in the forenoon, and finished late in the evening showed this formation only in the parts finished last. The floors finished during November, when there had been frost and often temperatures below zero, were always covered after pouring with straw mats. These showed very little of the ice crystals, and in many cases none at all. These tests were made on slab beam floors with comparatively light compression beams and on slab panel floors at 10-12 cm. (4-4.8 in.) thickness. Floors which had been poured during milder weather showed none of these phenomena.

The beams made during the coldest part of the season show great decrease in strength. The average strength after four weeks is only 310 (4,402), after six weeks 330 (4,686) and after six months only 360 kg. sq. cm. (5,112 lb. sq. in.). Other beams

FIG. 3—MAKING TEST BEAMS AND CUBES ON THE WAR DEPARTMENT BUILDING, VIENNA.

poured during low temperatures, but not exposed in the same night to frost give, after four weeks a strength of only 200 kg. sq. cm., (2,840 lb. sq. in.) and those exposed to frost the night after pouring give only 130 kg. sq. cm. (1,846 lb. sq. in.) and after six months only 165 kg. sq. cm. (2,343 lb. sq. in.). These beams do not even reach one-half of the standard strength, although they were exposed to a cold or cool temperature only for one week at the most, and the rest of the time to a temperature of + 15° C (59° F.) at the lowest.

Two of the series, in which the beams were made in March, show great strengths, namely 300 (4,260) after four weeks, and 340 kg. sq. cm. (4,828 lb. sq.in.) after five months. The temperature in the night following the concreteing rose to + 4° C (39° F.), and drop to — 2° C (28° F.) in the following night seems to have been unable to influence the beam in any way.

The excellent results and the observations of these tests were made possible to some extent by the uniformity of the cement furnished by the cement works. The gravel was the only part of the aggregate that gave some trouble, being often too coarse. A different kind of gravel was tried, which with its soft sand seemed to be better than the previous aggregate. The control beam tests showed, however, that the strengths with this new aggregate were very low, and the department then returned to the former gravel.

Another proof of the accuracy of the control beam is shown by the low strengths obtained with beams, where the reinforcement was not in the correct position. If one or the other of the two reinforcement bars was placed either too high or too low, the results were at once away from normal. The differences amounted in some case to 60 kg. sq. cm. (852 lb. sq. in.), the beam being tested after 14 days.

The control beam tests followed the directions of Dr. von Emperger closely. The various parts of

FIG. 4—BREAKING A TEST BEAM.

the beam forms were held in iron clamps to get accurate beams, and were left in the forms for 3 or 4 days. The beams were then taken out of the form and left at the building, exposed to the identical conditions to which the real floors were subjected. Fig. 3 shows the beams in position and the testing load of building bricks. The breaking of the beam occurred always in compression, often accompanied by a crack starting at the breaking point and extending along the position of the steel reinforcement. The beams with 4 per cent reinforcement showed such cracks in the tensile zone as a rule only when the tensile stress on the steel neared 3,000 kg. sq. cm. (42,600 ft. sq. in.) which corresponds to a compressive stress on the concrete of 380 kg. sq. cm. (5 396 lb. sq. in.), which is considerable, and hardly surpassed by concrete made for practical construction purposes and tested after 4-6 weeks.

As regards the relation of cube tests to control beam tests, no law could be established, although cubes and beams were made at the same time and tested under similar conditions. The following table gives an idea of the tests of similar cubes and beams:

TABLE I.—RELATIVE UNIFORMITY IN CUBE AND BEAM TESTS.

No. of cube		I	II	III	IV	V	VI	Average	Variation from Average		Total Variations of averages
No. of beam		9	19	29	39	49	59		Upward %	Downward %	in %
Cube Strength	lb. sq. in.	3578	4189	3252	2527	3919	2399	3309	+27	−27	54
Compressive strength in	lb. sq. in.	4667	4487	4558	4558	5055		4686	+ 8	− 5	13
Relation between above values		1.3	1.1	1.4	1.8	1.3		1.4	+29	−21	50

If we take the average strength after 14 days at 250 kg. sq. cm. (3,550 lb. sq. in.) omitting all abnormal strengths, either above or below the normal, and call this figure 100, we can make a comparison as regards temperature influences. The figures in Table 11 will then give the relation to the normal strength, expressed in the relation to the accepted standard given above set equal to 100.

TABLE 11.

TEMPERATURE INFLUENCE ON NEW CONCRETE.

		14 days	4 weeks	6 weeks	6 months
Normal Temperatures above +5°C	Maximum	124	144	152	160
	Average	100	120	132	140
	Minimum	80	100	116	124
Above 0°C up to +5°C		64	82	92	
0°C and below		44	52	56	66

NOTE: The strengths actually reached in these tests are 35.5 times the accompanying figures, equal to lbs. sq. in.

This practical demonstration of the value of the tests should be of great interest to the builder, and favor the more extensive employment of the control beam test. The beams were made in every instance by the workmen on the building and illustrated the simplicity and ease of the test. As regards the amount of concrete and steel needed for the execution of the tests, the following figures may be interesting: 1.5 cu. m. (42.9 cu. ft.) concrete and 836 lb. steel were used for the test beams, which is insignificant when compared to the total quantity of concrete and steel put into the entire building. The cost from the standpoint of material is therefore very low, when contrasted with the accuracy of the tests and the results obtained.

Reinforced Concrete Letter Boxes and Poles

Consul General William A. Prickett, Auckland, sends the following clipping from the New Zealand *Herald* concerning the use of concrete letter boxes and poles, the article appearing in the *Daily Consulor* and *Trade Raports* of Jan. 3:

The Post and Telegraph Department of the New Zealand Government has commenced to use telegraph poles and pillar letter boxes made of ferroconcrete.

The contract for making the ferroconcrete poles is being carried out at Freemans Bay (Auckland). Poles to the number of 1,265 are already completed for the metallic circuit between Auckland and Hamilton, and the work of erecting them will shortly be commenced. Exhaustive tests have been carried out for the department, and the strength of the poles is calculated to be sufficient to carry any lines that are required. Angle poles which are subject to great stress have been found to be very serviceable in the ferroconcrete material. For ordinary straight lines the poles are 6 by 8 in. at the base, and 6 by 6 in. at the top, the length being 26 ft. The angle poles are, however, much stronger. These are 11 by 8 in. at the base, 8 by 4 in. at the top, and 30 ft. long, made hollow to reduce the weight.

For more than a year experiments have been carried on for the department, with the object of making a concrete pole that would be much lighter than those made from the ordinary ferroconcrete. The experiments have been most successful. By a new process poles can now be manufactured which are very little heavier than totara wood. Tests recently made with an 18-ft. pole showed that it could carry a greater weight than either wood or iron. Although the hollow in the ferroconcrete poles materially reduced the weight, they were not nearly so light as the poles made with the new material. The average life of a wooden or iron pole is set down at about nine years, while it is considered that the ferroconcrete poles and those chemically treated are practically everlasting.

PILLAR BOXES: It is now the intention of the Post and Telegraph Department to have pillar boxes constructed of ferroconcrete instead of the iron boxes now in use. Tests show that these boxes are stronger and lighter than iron, while the cost is said to be only half.

These pillar boxes are constructed after a patented design that obviates the necessity of the postman having to open the door and handle the letters. In the new boxes there will be no door in the front; the opening will be placed underneath. When letters are to be taken out the postman will run his bag along a couple of grooves made for the purpose, and the door will open into the bag, there being no occasion whatever to handle the letters.

British Cement Consolidation Scheme

For some time past there have been more or less vague rumors of a coming amalgamation of certain cement-producing businesses in England; and now it is stated in the *Financial Times*, of London, that at the interim general meeting of Martin Earle & Co. the directors submitted a proposal that the shareholders should agree to exchange their holdings for the capital issues of a new concern.

"In the circular issued to the shareholders in connection with this matter," our contemporary observes, "the directors stated that they had been approached by certain important interests who were intent upon the carrying through of a consolidation scheme, which should result in the formation of a new company, * * * capitalized at between £3,000,000 and £4,000,000, while the capacity of the various plants to be acquired was estimated at something over 1,200,000 tons. The name of the new undertaking will be the British Portland Cement Manufacturers. * * *

"One of the chief points in favor of the scheme of consolidation," the *Financial Times* states, "is that it will entail in many cases a substantial reduction of the capital of the concerns taken over, and, while this may not be a very agreeable process for those who have to submit to it, the result will be to put the finances of the trade on a sounder footing than at present. * * * The desirability of organizing the industry on this basis has been apparent for some years, and it is now probable that the negotiations to this end will soon be completed. It will then remain for foreign producers to decide upon their line of action, unless, as many people believe will be the case, an understanding is arrived at with them in the interval."

TIMBER FLOORS ON A SKELETON FRAME OF REINFORCED CONCRETE

By Francis W. Wilson*

A FACTORY building constructed with a skeleton frame of reinforced concrete possesses certain obvious advantages over the usual type of brick building of "Mill Construction," (sometimes referred to as "slow burning construction"), but in general these advantages have not been recognized by the parties who should be most interested,—that is to say by the factory owners themselves.

Aside from any comparison of first cost, the self-evident advantages obtained by using the skeleton frame of reinforced concrete, are—

First: Greater rigidity due to the monolithic construction, doing away with vibration in the building.

Second: Greater window area possible than with mill construction.

Third: Affords a more permanent structure, with a minimum of possible depreciation.

Fourth: Greater fireproofness.

Fifth: Permits of longer spans for beams and girders, or in other words requires fewer interior columns or posts.

Other advantages might be mentioned, but the above are among the most obvious, and it would certainly seem that if these could be substantiated there would be no reason why any factory owner would consider constructing a new building in the usual type of mill construction with brick walls, but nevertheless there are more buildings of mill construction erected in the New England States at the present time than all other types of construction combined.

One reason for this, of course, is the fact that a building of the usual type of concrete construction will cost more than a similar building of mill construction, and very many factory owners appear to look into the first cost only. Furthermore some owners have seen some unsightly building of concrete construction somewhere, and that has settled it for all time in their minds that they "prefer a brick building." If they were to be shown a building with a concrete skeleton frame and brick curtain walls, they would call it a "brick building," and consider the appearance unobjectionable,—but refer to a concrete building and they often conceive of it as being built with concrete walls, more or less unfinished and streaked, and their objections are very decided.†

The attitude of many mill architects and engineers toward reinforced concrete buildings for factory purposes has been, and is yet, unfriendly in many cases. This holds true even among some of the best known individuals and concerns engaged in this line of work. This point of view is difficult to understand, by any one with experience in both types of construction, but nevertheless it is a potent factor in limiting the introduction of concrete buildings for factory purposes, since many owners will be governed by the advice of their mill architect or engineer, whether the advice in all cases justifies their confidence or not.

Floors in the majority of concrete factory buildings have been constructed with a cement finish (sometimes referred to as a "granolithic" finish) on top of the concrete slabs. This has at times proved to be objectionable for use in many kinds of industrial buildings. The floor finish does not at times stand the wear of running hand trucks over it, and even where these are not used it is no uncommon thing for the top surface to commence to "dust up" after it has had only moderate use for a limited time. Any owner who has had experience with a "granolithic" floor of this kind can be pardoned if he has conceived a lifelong prejudice against that particular feature of concrete building construction.‡ A wood floor constructed over the concrete slabs is an additional expense not often favored by the owner and not generally advocated by concerns engaged in promoting concrete building construction.

About three years ago the writer had a conversation with one of the largest mill owners in New England in regard to the possibility of using concrete construction for some new buildings. The gentleman in question expressed himself as being strenuously opposed to any concrete building for mill purposes. His one and only reason was that, after a mill was completed it always happened that a number of holes had to be cut through the floors for chutes, belting, shafting, or other purposes, and he would have nothing but wood floors for that reason. At the time this seemed to be an insufficient argument against what was otherwise a satisfactory construction, and yet since that time I have had this in mind in going through existing factory buildings, and I concede the point that this matter of cutting holes through the floor is very important, and it does not appear that all the necessary openings can be foreseen and provided for at the time of construction.

One feature of the usual type of concrete factory building which has helped to keep the first cost within reasonable bounds, is the use of a "skeleton frame" for the wall construction. This

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†[The authors statements in the above paragraph are more or less open to criticism. There should be in New England at the present time, many reinforced concrete structures which would demonstrate to any skeptical owner the efficiency of this material for factory construction. The recent book on "Concrete Factories," should be a great help in changing the opinion of factory owners adverse to concrete construction.—EDITORS.]

‡[This opinion also mighe be revised according to the point of view. Readers would do well to consult "Wearing Surfaces for Concrete Floors," published by the Aberthaw Construction Co., of Boston. A well-built "granolithic" floor should not dust. —EDITORS.]

means that the actual curtain walls are only provided to keep out the weather, and they need be no thicker for an eight or nine story building than they would be for one story. On the other hand the usual brick building of mill construction with bearing walls must have heavier wall construction as the height increases.

The average factory owner has always been accustomed to wood floors in his buildings, and there is probably no other single detail of building construction which he tends to cling to so tenaciously as the wood floors.

It was the writer's aim in designing the type of construction described in the following, to combine as far as possible all the good points of the usual type of reinforced concrete factory building construction, as for example, the skeleton frame wall construction and at the same time preserve the wood floors of mill construction.

The difficulty of doing this and at the same time using T-sections of concrete beams and girders to which the floor could be satisfactorily attached, was evident at the outset. Any attempt to support a

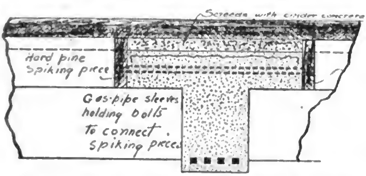


FIG. 1—DETAIL SECTION OF T-BEAM SHOWING SPIKING PIECES AND TIMBER FLOORING.

plank flooring on rectangular sections of beams and girders meant either excessive depth or excessive width in order to provide sufficient concrete to develop the required reinforcing steel (or, in other words, to provide sufficient concrete to keep the stresses on the concrete within allowed limits.) Rectangular shaped sections, if otherwise possible, meant a sacrifice of all economy in the cost of the construction as compared with the usual concrete slab floors.

The details shown herewith in Figs. 1 and 2, represent the manner in which the plank floors have been attached to the concrete *T*-beams and girders in the actual construction of a number of buildings of this type. This detail affords a ready means of spiking the floor plank to the spiking pieces at each side of the beams and girders. The planks are not actually in contact with the concrete but rest upon a fill of cinder concrete on top of the *T*. This does away with the danger of the floor plank rotting away as it might tend to do if directly in contact with the concrete.

Splined plank are used and the strength of the plank is figured for the unsupported length as would

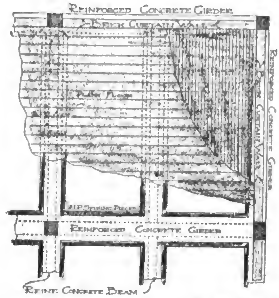


FIG. 2—PLAN SHOWING SKELETON BEAMS AND GIRDERS WITH TIMBER FLOORING.

be done in the case of the ordinary floor of mill construction. A finished floor of maple is usually laid over the plank floor.

The economy of this construction is readily apparent if we consider the comparative dead load of a floor of this construction with its supporting beams and girders as against the dead weight of a floor of the same strength and provided with the usual concrete slab. The lighter dead weight means that less reinforcing steel and less concrete are required for the same live load. It is self evident that less centering and forms are required for this construction, and that being accessible from above as well as below, that the labor of erecting and removing the forms must be less than for an all-concrete building. The wall construction costs no more and no less than that of the usual concrete building. Therefore, if we save in steel and concrete, and in lumber and labor required for forms, and lose nothing in the wall construction, there must be a considerable net economy in the use of this type of building.

Actual comparisons of cost show that, for equal strength, this type of construction can be built, by contractors experienced in its application, for from 15 per cent to 25 per cent less than the usual types of concrete buildings with solid concrete slab floors.

While the wood floors with supporting beams and girders of reinforced concrete will generally cost more than floors of ordinary mill construction, yet the walls will cost less than the usual brick walls of mill construction if the building in question is more than two stories in height. This is due to the economy of the skeleton frame construction for the walls, as compared with the heavy brick wall construction required for mill construction. Considered as a whole the cost of the construction herein described will compare favorably with the cost of the same building if built of mill construction for all structures more than two stories in height. Actual

cases tried out by bids from contractors have shown a net saving of as much as 10 per cent in favor of the concrete beams and girders with wood floors.

A sprinkler system is installed in the majority of factory buildings now in use. This is generally done for the protection of the contents of the factory even where the buildings themselves are of fireproof construction. Where a sprinkler system is installed the insurance rates on a building with the wood floors and beams and girders of concrete, are almost as low as those offered on buildings of absolutely fireproof construction. The Mutual companies make a very slight difference in favor of the fireproof building, but they make a rate materially lower than the rate on buildings of mill construction. In a recent case one of the "stock" companies made a rate to the owners on a building with the wood floors and concrete supports which was just as low as they offered if the building in question had been of fireproof construction. The matter of insurance rates was, of course, of considerable importance to owners when considering the use of this type of construction, and the writer took up the question of a rating on this construction with some of the local "stock" companies before any actual example of this type of construction had been built. At that time they were not disposed to grant any better rates on the construction with concrete columns, beams, and girders than they would if these structural parts were of hard pine. This attitude has somewhat changed as the foregoing would indicate.

A recent example of the use of this type of construction is in the new factory building for Chas. W. Dean & Co., at Natick, Mass. The main building is 50 ft. wide and 288 ft. long and has an "ell" in front, 29 ft. 6 in. by 32 ft., and one in the rear 16 ft. by 49 ft. The office building in the front of factory is 22 ft. by 72 ft., and is one story and basement in height. The factory building is four stories and basement throughout. All story heights are 12 ft. 4 in. from floor to floor or 10 ft. in the clear.

The actual cost of the factory building is impossible to arrive at accurately, since the contract price included also the office building in front of the factory. The office building being narrow and of relatively small size, and provided with a high grade of finish both on the exterior and interior, any figures which included its cost with that of the factory would only be misleading.

As nearly as can be determined however, the factory building proper actually cost 90 cts. per square foot of floor area. This figure includes everything ready for occupancy except the plumbing, heating, lighting and sprinkler system. Two elevators were installed, one in each of the two ells or towers. The elevators were provided with Kinnear rolling shutters at each floor level, and both elevators are enclosed with 8-in. brick walls. Automatic fire doors separate the towers from the main factory. There are two iron fire escapes on the rear of building. An iron stairway, with wrought iron balustrade runs from basement to the top floor. This stairway is 7 ft. in the clear.

The actual cost would have been less than it is if the owners had been satisfied with lighter floor capacity. They insisted on a live load capacity of 200 lb. per sq. ft. of floor, although it is doubtful if there is any actual occasion for such floor capacity in a shoe factory. If any one doubts this let him visit some of the old wooden buildings used for that purpose.

In designing the reinforced concrete work for this building the allowed stress on steel in tension was taken at 16,000 lb. per sq. in. The allowed stress on concrete in compression in beams and girders at 650 lb. per sq. in. at outer edge, or, in other words, "on extreme fibres." The concrete in columns was stressed to a maximum of 500 lb. per sq. in., but no material reduction was made in figuring the column loads. That is to say that the compression on column concrete would not exceed 500 lb. per sq. in. if sustaining practically the full live load.

It is not probable that this building could have been built of mill construction for any less money if it were designed for the same floor loads and spans and furnished with the same fixtures in the way of elevators, iron stairs, fire escapes, etc. If we consider the relatively narrow width of 50 ft., it is quite possible that for the same conditions a building of mill construction might have cost more. A direct comparison was had with the cost of the same building designed in the usual type of concrete construction. Contractors bids (the lowest) were 25 per cent higher for the usual concrete construction than for the building as built.

A recent issue of one of the leading engineering periodicals cites the case of a new factory of mill construction which had to be practically rebuilt at the end of four years due to "dry rot" in the lumber used. Another building of mill construction collapsed during a moderate fire in 1909, the immediate cause of the collapse being due to "dry rot" in the lumber and not due to the fire. It is well known that the lumber now obtainable in large sizes suitable for use in mill construction is much inferior to that obtainable for the same purpose only a relatively few years ago.

It would certainly seem that the time has arrived when both the factory owners and the mill architects should give attention to securing a better and more permanent type of construction for factory buildings and particularly if such can be secured without any additional outlay in the first cost of the work.

The type of floor construction herein described was patented by the writer on August 1, 1911.

COLD WEATHER CONCRETE WORK

By John S. Nicholl*

ALL authorities on concrete construction agree that provided the proper precautions are taken the results obtained by placing concrete in winter are practically as satisfactory as those secured in summer weather, and point to buildings erected in winter that are now giving absolute satisfaction, and also practical tests as proof of their statements. They recognize the extra expense of concreting in winter, but realize that under certain conditions, this is offset by the saving due to primarily the quicker occupancy of the building. Even in cold New England, construction companies have executed some of their most important work in winter and the present conditions of the buildings are so excellent that they do not hesitate to say that they have confidence that the results they can show on winter concrete work are the equal of any of their warm weather construction. If time permits, contractors advise construction in warm weather, solely on account of the cheaper cost, but are assured that they are capable of obtaining the same quality in winter as in the summer.

Generally speaking, the advantages of concreting in the winter time are usually overlooked. In the first place, in the Northern States the average man looks upon a winter as one long continued cold spell, while as a matter of fact, there are mild spells of considerable duration when no precautions are necessary to keep the concrete from freezing and the efficiency of the gang is about as good as in the summer. Another point is the fact that labor is usually cheaper in winter than summer and the same is true to some extent of the materials of construction, deliveries of which are more prompt, thus minimizing the increased cost due to delays. Furthermore, the construction companies themselves are often able to take work at lower figures. It should be added that although the cost of concrete buildings is slightly higher if erected in the winter than in the summer, the same is true of most any type of construction and should not be charged against concrete construction too severely. It might be said that the cold weather decreases the efficiency of gangs, all of which is true, but considering the lower wages paid, the amount of labor obtained per dollar is practically the same as in the summer.

*Boston.

The main point to be taken care of in concreting in winter is to keep the concrete from freezing until it has time to set and harden, and the results obtained by practice and tests indicate (1) that most Natural cements are ruined by freezing; (2) that the setting and hardening of Portland cements is retarded by freezing, the strength at short periods is lowered by freezing, but the ultimate tensile strength is only slightly, if at all, affected. From this it will be seen that concreting in winter with natural cements is out of the question and only Portland cements are considered here. An extensive series of experiments upon frozen mortars was conducted by Thomas F. Richardson, at the Wachusett Dam in Massachusetts, and the conclusion was reached that Portland cement mortar is not permanently injured by freezing. Other experiments, as P. Alexandre in France, and Charles S. Gowen and Prof. Tetmajer express the same opinion.*

In using Portland cement the point should be brought out that especially with high grade Portland cements a high internal heat is produced when setting. Tests by J. E. Howard at the Watertown Arsenal showed that first-class American brands of neat Portland cement often reached a maximum of 212° F. while the maximum with various brands

FIG. 1—NEW 10-STORY WAREHOUSE AND FREIGHT TERMINAL OF THE LARKIN CO., AT BUFFALO, N. Y.

Note the use of canvas on upper floors. The last four stories were concreted in winter of 1911-1912.

*These references are taken from "Concrete, Plain and Reinforced," by Taylor and Thompson, which can be consulted for more detail data.—J. S. Nicholl.

of American Natural cements was generally from 95° to 104° F. and the high temperature was reached in a shorter time than with the Portlands. With Portland cement concrete the rise is less than with neat Portland, but in mass work a temperature of 100° F. may be reached.† The above may be a reason for the prevention of injury from frosts in certain cements.

FIG. 2—REINFORCED CONCRETE DAM ACROSS THE ANDROSCOGGIN RIVER AT AUBURN, ME., BUILT IN WINTER OF 1907-1908.

Concrete work in winter may be successfully carried on by one or two methods or a combination of both. One procedure is to heat the materials and protect the work until it has sufficient time to harden and the other is to lower the freezing point of the concrete. This latter method is probably the simplest and cheapest, but not the best, and consists in adding some substances as salt or calcium chloride that does not affect the strength and durability of the concrete. Experiments have shown, however, that the time of setting is considerably increased and the strength at short periods is lowered.‡ Approximately one per cent by weight of salt to the weight of water is required for each degree F. below freezing, but more than 10 per cent of salt is not considered safe and this amount is not effective, for temperatures lower than 22° F. Sanford E. Thompson has adopted the arbitrary rule of two pounds of salt to each bag of cement used, since in practice it is quite impossible to foretell the lowest temperature that will be reached. The convenient way to add the salt is by putting it into the mixing water. Calcium chloride in quantities not over 2 per cent of the weight of cement lowers the freezing point in an effective manner, but a larger amount hastens the set to such an extent that it is difficult to handle.

To heat the material many methods are used and in some cases all are heated while in others either the sand and water, or stone and water are only heated, depending entirely on conditions. Heating the materials accelerates the rate of hardening and lengthens the time before the mixture becomes cold enough to freeze, and results show that the materials should not be heated much over 90° F., as the concrete is weakened by the set being too rapid. Of course, in some work, such as thick walls, abutments, etc., it is not necessary to heat the sand if it is dry and free from lumps of frozen matter. The water, however, should be heated, and if the concrete is poured unchilled, rapid hardening will take place, as in mass work, as pointed out before, a considerable amount of heat is generated within. With tight forms of heavy material only the exposed surface of such work need be protected and this may be done by covering with a tarpaulin and applying a jet of steam or by covering with boards, building paper, or straw. Of course, for placing thin walls, columns, floors, beams, etc., much more care is required.

†See Taylor and Thompson, page 130.
‡Above reference, page 325.

As far as heating the water is concerned, the ordinary method of placing a steam pipe in the barrel is not advisable for the water in most cases is used too fast to permit of its being properly heated by this practice. A better way is to provide a suitable tank, heating the water therein by a coil of pipe supplied with steam from the boiler running mixer engine or from some other source.

The method employed in heating sand and stone depends upon whether these materials are received by rail or wagons. Where material is received on flat cars some companies usually run a steam pipe alongside of the tracks with tees at various points to which steam hose is connected and steam is allowed to flow directly into the bottom of the stone-filled car.

For heating the sand the Aberthaw Construction Co. usually run perforated steam pipes through the pile and keep the pile covered with canvas. Half-cylinders of sheet steel placed upon the ground in an arch form constitute a simple sand heater, while lengths of metal culvert pipe closed at one end and provided with a short piece of smaller pipe for a flue have been used. An ordinary sand heater, such as is employed in asphalt work, may also be used

and the stone heated by steam from a hose.

At the Pacific Mills Print* works a somewhat different method was used. Here the floors as laid were covered with about 12 in. of straw, free from manure, and the columns and girders underneath were protected by canvas walls and the interior was heated by salamanders to about 30 degrees above outside temperature. In one of the views is shown the workmen laying on the granolithic wearing surface on a finished slab. The surface obtained is very satisfactory and this is one of the most difficult results to obtain. Often a thin scale is apt to crack from the surface unless proper precautions are taken.

The storage and nickel plating buildings (Fig. 5) of the Pierce Arrow Motor Car Company at Buffalo, N. Y., were erected during the winter of 1909-10. The storage building in the background of the illustration was started the first of October and although severe winter conditions were experienced the building was delivered to the owners February 1 following. The nickel plating building in the foreground was started January 1, 1910 and the last concrete was poured April 2 following. The reinforced concrete warehouse of this plant is a 4-story structure, 308 ft. by 62 ft. with a wing 105 ft. by 51 ft. It has a reinforced concrete skeleton frame with brick curtain walls and mushroom floors which were designed for live loads of 150 lb. per square foot.

In freezing weather the stone and gravel were heated by live steam at low pressure from the central power plant. The contractors used a flexible steam connection with outlet which was buried in the material and the same was allowed to percolate through it until it was heated enough to use. The water for mixing the concrete was heated by passing through the pipes coiled in a salamander. The aggregate was largely dredged gravel, which proved exceptionally good material. When the proportion of sand was excessive it was mixed with crushed stone. The material was dumped from cars into the mixer and a tipping barrel was used for the water. The mixer discharged into an automatic dump bucket and then hoisted to the desired elevation automatically dumped into steel V-shaped concrete cars, thence hauled by hand to point of placing.

At the 10-story warehouse and freight terminal of the Larkin Co., Buffalo, N. Y. (Fig. 1) the contractors placed concrete during the severe weather which has been experienced this winter. At times when the work was being executed the wind was blowing 30 to 50 miles an hour. The last four floors as they were put up were enclosed in canvas and the concrete was prevented from freezing by the use of salamanders. The pile of gravel used in the concrete was heated by 2-in. steam pipe carried from one of the 30 h. p. boilers in the temporary boiler house. The steam pressure used was about 40 lb. per square inch. The gravel, which was loaded onto rotary dump cars, was received at the mixer quite hot, in fact, so hot that it was uncomfortable to touch it. When it had been put through the mixer it was elevated to the floor under construction. When it arrived at the point of placing there was no perceptible heat to the concrete when tried by hand although it steamed both in the hopper and occasionally a little steam could be seen when it was dumped out of the barrows.

The building is 580 ft. by 109 ft. and covers over 14 acres of floor space. The mushroom system of construction has been adopted.

The dam built across the Little Androscoggin River at

*Built by the Aberthaw Construction Co., Boston.

FIG. 3—CONGRESS BLOCK, PORTLAND, ME., BUILT IN WINTER OF 1908-1909.

This building has a reinforced concrete frame with concrete floors and brick walls. After the foundations were in the floors were completed at the rate of a story a week notwithstanding the fact that more than half the concrete was placed in a temperature generally below 20 deg. The lower floor was figured for store loads and the upper for the usual office loads. The concrete used for the columns was quite rich.

Auburn, Me., is shown herewith as it appeared in the winter of 1907-08. This work was done for the Little Androscoggin Water Power Company and was a severe test for winter concrete work, but has given entire satisfaction. The dam is 225 ft. wide and has an average depth of about 35 ft.

In conclusion, it should be repeated that while construction companies do not advise concreting in winter they are ready to execute it and guarantee the quality to be as good as summer laid concrete, while the cost ranges from 10 to 15 per cent more, but this figure is often more than offset by the saving due to the early occupancy of the building, and other factors heretofore mentioned. The accompanying tables (table I) show the average temperatures in New England during the past 11 years; and table II, the days on which concreting could be carried on. The tables are on the following page.

Each minute of each day sees $500 in value rising in flame and smoke, with an ash pile as its legacy.

FIG. 4—PEJEPSCOT PAPER CO.'S MILL AND DAM TOPSHAM, ME., BUILT IN WINTER OF 1910-1911.

Ten thousand yds. of concrete were placed in severely cold weather. The concrete work, however, is excellent, there being no apparent leakage from the flumes or head gates. The dam is of the sectional "ogee" type and the proportions of concrete used were 1:2½:5. The dam is 135 ft. long while the mill itself is a building 116 by 112 ft. and with the exception of a 1-story brick superstructure is entirely of reinforced concrete, the mixture used being 1:2:4.

FIG. 5—THE PLANT OF THE PIERCE ARROW MOTOR CAR CO., AT BUFFALO.

The storage building in the background, and nickel plating buildings, under construction, in the foreground.

TABLE I.—MEAN MAXIMUM AND MEAN MINIMUM TEMPERATURES OF DECEMBER, JANUARY, FEBRUARY, MARCH, FROM 1900-1911.

	MEAN MAXIMUM				MEAN MINIMUM			
	Dec.	Jan.	Feb.	Mar.	Dec.	Jan.	Feb.	Mar.
1900	40.7	39.5	37.0	43.4	26.2	20.6	21.6	24.5
1901	39.5	34.6	31.1	42.0	25.3	20.5	17.4	29.5
1902	36.6	33.8	35.1	50.3	20.5	19.5	22.6	36.4
1903	36.6	35.9	38.5	52.5	21.3	21.3	24.4	36.4
1904	32.9	29.0	31.3	41.9	18.7	14.5	13.8	27.2
1905	42.6	32.5	31.1	45.2	27.6	17.7	15.7	29.1
1906	36.7	43.2	37.8	39.7	21.5	28.2	21.6	25.0
1907	43.9	34.6	30.3	45.3	30.5	19.4	13.0	30.5
1908	41.0	39.6	34.6	46.6	25.6	22.5	18.9	30.6
1909	36.4	38.1	40.6	43.8	25.1	22.5	24.7	29.9
1910	34.8	39.1	37.5	49.7	20.2	24.9	21.3	34.3
1911		39.6	34.4	43.1		24.0	19.5	27.8

TABLE II.—NUMBER OF DAYS IN DECEMBER, JANUARY, FEBRUARY, AND MARCH, FROM 1900-1911, INCLUSIVE, THAT MINIMUM TEMPERATURES WERE ABOVE FREEZING 32 DEG. F.

	Dec.	Jan.	Feb.	Mar.
1900	8	4	6	2
1901	11	1	0	9
1902	4	0	4	23
1903	4	7	8	24
1904	0	0	0	9
1905	12	3	0	11
1906	9	12	5	7
1907	13	10	0	0
1908	6	4	3	13
1909	9	6	7	11
1910	2	7	5	19
1911		5	2	12

The above temperatures are taken at the Boston Weather Bureau.

Fire Resisting Construction

Edward F. Croker, for many years chief of the fire department of New York City, delivered an address before a recent meeting of the International Municipal Congress, held in Chicago.

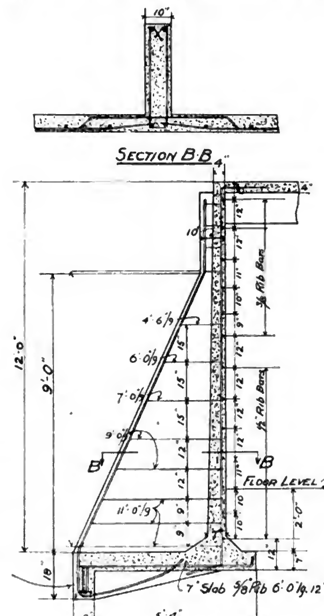
During the course of his remarks Mr. Croker was emphatic in his opinion that wood, even to the smallest percentage, should be eliminated from construction in any building that was to be classed as fireproof. Mr. Croker stated:

"If I had my way about it I would not permit a piece of wood, even the size of a lead pencil, to be used in the construction or finish of any building in the United States exceeding a ground area of 25 x 50 ft. or three stories in height. If there was still an absolute necessity for its use, if we could find nothing to replace it, it would then be well to attempt to conceive of something better. I am opposed to the use of wood in any form in fireproof buildings and the law ought not to permit its use. Wooden floors, wooden window frames, doors and casings burn and help other things to burn; wooden trim and bases burn—everything that is made of wood burns and helps the fire to spread. Eliminate wood—remove the cause and you have precluded the possibility of fires.

RETAINING WALL AT BRIDLINGTON, ENGLAND

ERNEST R. MATTHEWS, Assoc. M. Inst. C. E., F. G. S., Borough Engineer, of Bridlington, England, has designed, and has now under construction the retaining wall shown in the accompanying sketch. Following are some notes on the work from a recent letter received from Mr. Matthews:

"The reinforcement is on the Kahn system; the wall is 7 in. in thickness at base, and 4 in. at top,



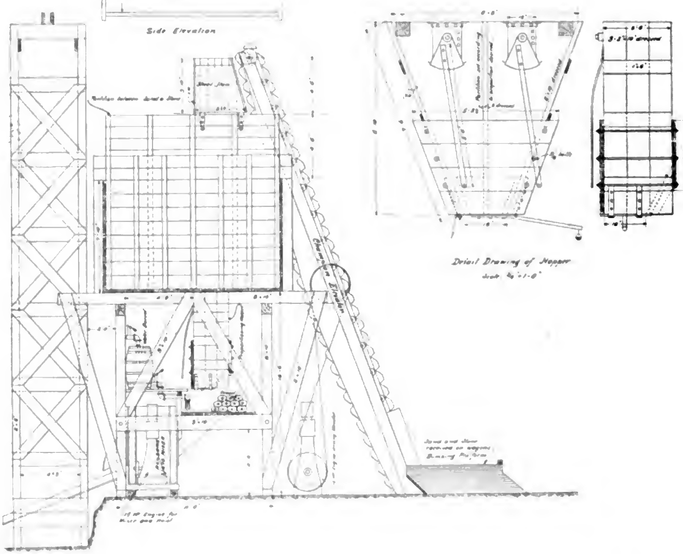
SECTION OF RETAINING WALL AT BRIDLINGTON, ENGLAND.

with 10 in. buttresses at 10-ft. centers. The concrete which is being used is in the proportion of 1:2:4. The wall is 12 ft. in height, 100 ft. in length, and by using reinforced concrete I estimate a saving of 25 to 30 per cent."

The Royal Testing Station at Berlin is now making tests on the influence of alum and soap on the setting of cement and on the strength and waterproof qualities of cement mortar.

AN ECONOMICAL CONCRETE PLANT.

The concrete materials are raised by bucket conveyor from the dumping platform to a bin directly over the mixer hopper, and are fed into the mixer by gravity.



Lumber for Forms

In concrete form work, tongue-and-grooved stock is most common for sheathing, although ship-lap is used sometimes and bevelled edge is preferred by many, especially with dry lumber, so that when it swells the edges will crush without warping. Bevelled edge stuff is cheaper than tongue-and-grooved because with the latter there is ¾-in. of waste in the width of every board or plank. On the other hand, for sheathing which is to be used over and over again the tongue-and-grooved stock holds its place better and gives smoother surfaces.

The thickness of face boards should be absolutely uniform to prevent unevenness in the surface of the concrete.

In figuring from work, the best engineers recognize the necessity of considering each individual building independently in estimating form lumber, instead of assuming for all an approximate price per square foot or per cubic yard of total concrete.

AN ECONOMICAL CONCRETE PLANT

IT sometimes happens that several different designs of concrete plants for a given job promise equal economy and it is then that the selection often depends on the adaptability of the plant either in whole or part for use on some other job. An instance where the choice was made with foresight is afforded by the mixing plant used at the American Can Company's new reinforced concrete factory located on Beach and Palmer streets, Philadelphia.

This concrete plant is equipped with a ¾-yd. Ransome mixer and has turned out 9,200 yds. of concrete for the new building, which is five stories high with basement and has overall dimensions of 346 ft. by 100 ft. At times 290 yds. have been mixed in a trifle less than 11 hours, or 25 per cent over normal rating. The plant has been very satisfactory and has been so made that it can be taken down and will be used in the construction of the new West Philadelphia High School where 8,000 yds. of concrete will be mixed. This will mean no small saving to the contractor.

An inspection of the accompanying illustration will make perfectly clear the course the materials follow. The sand and stone, the latter mostly ¾ in., are dumped from wagons onto the platform and raised by a bucket elevator, driven by a 10-horsepower engine, to the sand and stone bins at the top. The stone bin has a capacity of about 48 yds. while the sand bin holds about 20 yds. From this point the aggregates fall by gravity into a proportioning hopper being admitted through gates. The hopper is provided with a partition that can be set according to proportion desired.

Below the proportioning hopper is the fixed batch hopper of the ¾-yd. mixer operated by a 15-horsepower engine that runs the hoist also. The cement is piled in bags alongside of the top of the mixer's hopper and water is turned into the latter from a pipe leading from a marked water barrel connected to the city mains.

The concrete is proportioned 1:2:4 and is discharged into Ransome hoist buckets that are unloaded at the proper point. The tower is of wood, simply made, and is 110 ft. high.

From the drawing will be noted the simplicity of construction of the entire plant, the ease with which it can be taken down, and the fact that the materials do no travel a foot more than necessary. The contractors on this job are Cramp & Co., of Philadelphia, with F. V. Warren in charge.

Reinforced Concrete Railway Work in Mexico

R. W. Whitaker, in *Engineering News*, Nov. 30, describes interesting reinforced concrete railroad work at Vera Cruz, Mexico, which was adopted as the best material to withstand corrosive influences of the climate. The work includes umbrella roofs over four passenger platforms which are each 493 ft. long and 23 ft. wide and are supported by columns spaced 16.5 ft. apart. The roofs have been designed to carry dead load only and to resist the wind pressure of the "northers," which occur nearly every week during the winter season. Two of these roofs were unexpectedly subjected to a test loading, during a political demonstration, when several thousand people gathered at the station to witness the arrival of a presidential aspirant. A large number of the more ardent supporters climbed onto the roofs and it was with difficulty that they were prevailed upon to seek a more safe point of vantage.

Another feature of note is the reinforced concrete roof over the concourse, which is supported by bow spring trusses.

CONCOURSE OF RAILROAD STATION AT VERA CRUZ, MEXICO.

HARDNESS OF PLASTERS AND CEMENTS, AND A SIMPLE CHRONOGRAPHIC APPARATUS FOR RECORDING SET

By Dr. Chas. F. McKenna*

ONE cannot give a clear definition of the term "hardness" which shall serve for all the meanings in which it is used. The mineralogist using Moh's Scale, always means by this a measure of resistance to scratching or abrading; the woodworker means the resistance to cutting; the steelmaker sometimes means by it the resistance to deformation under applied loads; in fact, indentation tests rule in many fields rather than scratching, cutting, or any other form of test.

In the case of hydraulic cements, the first stages of hardening have been usually measured by resistance to penetration; the later stages by finding the increase of cohesion determined by resistance on uniform cross-section to tractive or compressive forces gradually applied until rupture occurs.

The setting of plasters and cements is the very first stiffening and rapid development of cohesion up to the stage where needle points under moderate pressures do not penetrate the surface, or where small test objects are easily handled without fracture. Beyond this the phenomenon in which the cohesion due to complex mineral-forming reactions is step by step increased until a considerable age is reached, is called the hardening.

The chemical phenomena occuring in the setting of plaster of paris are chiefly those due to the energy in supersaturated solutions. Where a small proportion of water is used a hydrated sulphate of lime of one form goes into solution and the concentration causes the settling out of solidification of another form of hydrated sulphate; the water released from this helps to dissolve more of the first form, which by concentration, duly deposits again, and thus the process is continuous to total solidification. Similar phenomena can be observed in supersaturated solutions of some salts, which can be caused to deposit crystals and thicken almost to total solidification. The setting of such a compound of hydrated sulphate of lime is rapid, and except for effects of drying, the maximum hardness is obtained a very few hours after the gauging.

In the setting of hydraulic cements we have something much more complex, though we have been instructed by the case of plaster and by some of the points of similarity in it.

Powdered cement clinker, our commercial Portland cement, is a simplex solid solution of silicates and aluminates rich in lime. When it is wet the alkaline lime solution resulting reacts on the silicates, producing a colloidal mass. A thermal effect occuring here in the beginning is the absorption of heat due to solution or the passing of the solid salts into the ionic condition.

*New York City.

In the setting of cement the first gelatinous mass formed is less and less permeable, due to drawing away of water coincident with the lowering of temperature; then as the crystal formation begins, the proportion of free water momentarily increases again and softens the colloids. Later the full interlacing of crystals and the drying of the colloids admit less and less of penetration, and thus we have the development and finally the end of the process of setting.

Hardening can then go on through further molecular interchanges leading up to the formation of silicates of lime and alumina analagous to some of both colloids and crystaloids.

According to Michaelis,* the exact steps are described as practically a migration of water throughout the mass. The first particles of clinker are dissolved on the surface, the super-saturated lime solution thus formed reacts to form a gelatinous mass, and when crystals of aluminate of lime are formed the water separated goes further to attack newer particles of the clinker nodule, later deserting the colloids formed and passing into the air or into the water in which it is immersed.

These reactions are complicated again by the presence of sulphate of lime, which serves to form with the aluminates of lime a double compound of slow setting qualities, neutralizing the usual effect of a cement rich in aluminates of lime, where the setting is very quick and the development of heat sudden and great. Thus you will observe we consider setting to be consequental upon the formation of both colloids and crystaloids.

Apparatus for observing these changes in the setting process have usually been simple. For expert workers it suffices to use the thumb nail. With skill and accustomed observation they thus obtain a definition which is as remarkable as the means are simple. Nothing has been developed towards providing means for observing set in plaster of paris; the contraction and dilatation, however, have been observed by Van Hoff in a beautifully simple apparatus.

FIG. 2—THE GENERALLY USED VICAT NEEDLE.

General Gilmore recommended, for observing set in Port-

*"Concrete Engineering," November, 1909.

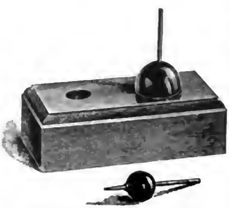


FIG. 1—GENERAL TYPE OF GILMORE NEEDLE.

land cement, a weighted coarse wire and a more heavily weighted fine wire (Fig. 1) for the determination, respectively, of the first stiffening (initial set), and the firm resistance to any penetration or deformation (final set). Neither of these methods is instrumental or fitted to record distinct differences.

The first apparatus designed for such a purpose was that of Vicat, the French chemist and authority on cements. The well-known Vicat needle (Fig. 2) is a weighted one, cylindrical and 1 square millimeter in area on the face, moving in a vertical and scaled-off guide and falling upon the mass of gauged cement in the mold below. The initial set is taken as the time at which the needle will not penetrate within a certain distance of the bottom of the mass, and final set as that time when there will be no mark on the surface from the needle.

However, chronographic and automatic apparatus have been sought for.

Protessor A. Martens, of Charlottenburg, designed an apparatus in which needles energized by magnets are dropped and raised again as a clock movement makes the contacts.

The Amsler-Laffon cement seting recorder (Fig. 3) has been used in Europe. This is described in the journal *Cement*, from which the following description is taken:

In testing the activity of cements by this apparatus two molds are filled with a plastic paste and two needles are lowered upon the cement at certain intervals, penetrating more or less into the mortar according to the progress of setting. The depth to which each needle enters the mortars is recorded on a drum by two separate pencils. After each stroke of the needles the drum turns a little and the table on which the molds rest advances a step from right to left. The needle holders are lowered and raised by a lever, which is set in motion by a spiral spring; a clock movement lets loose a governor and stops it again when the strike of the lever is completed. The diameter of the needles is one millimeter. The weight of each needle-holder is 300 grams.

The Nicol spissograph,* the invention of R. Gordon Nicol of Aberdeen, Scotland, and made by A. & J. Smith of that city, is similarly designed. This apparatus consists of a clockwork which raises and lowers every three minutes a pointed needle; at the same time the paste is rotated in a spiral to present a different spot to the needle at every contact. On the apparatus is a thermograph recording on the same chart the temperature of the air at the time the test is made. The whole is covered with a glass case and arrangements are made for keeping the temperature and humidity regular.

One of the best achievements in this line has been Geary's apparatus and the resulting investigations. He used the thermal changes during setting as the basis of study, and by photographing the changes of the mercury columns secured data for a chart. (Fig. 4.) Such a record as was thus obtained gives admirable indications of the energy

*Described and illustrated in detail in "Cement Age" for September, 1911, page 138.

FIG. 3—THE AMSLER-LAFFON APPARATUS FOR RECORDING THE SET IN CEMENT.

at work. None of these automatic instruments has been used in this country to the author's knowledge.

The following is an extract from the official report of R. Feret, Boulogne-sur-Mer, at the fifth Congress of the International Society for Testing Materials, held at Copenhagen in 1909:

Duration of Setting. The use of the Vicat Needle continues to be the only practical method in use for the determination for the duration of the period of setting of hydraulic cements. The appliance is of extreme simplicity, but its readings are sometimes uncertain, especially when it is a question of determining the end of the period; besides, the readings are of a purely conventional character and do not appear always to bear a sufficiently constant relation to the duration of the setting period of the mortars of actual practice. The discovery of more exact has therefore been attempted. Methods of testing based on the measured variations in the electric resistance of mortars while hardening have not given results of interest.

Other investigations have aimed at the definition of the setting by the determination of the temperature of the mortar during its continuance. Reasonably regular curves were obtained by this method, which, however, were dependent on the testing conditions and corresponded with chemical phenomena, the relation of which to the change of consistency called setting has not yet been quite clearly established.

The principal nature of this method to be employed may be the ascertainment of the time, reckoned from the commencement of the gauging, during which a given mortar can, with impunity, be further used without having to be revived by a fresh addition of water or a too violent mechanical treatment.

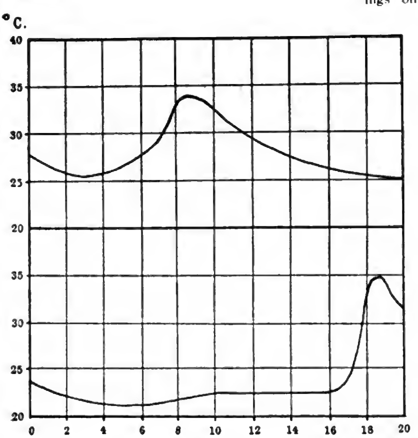


FIG. 4—GRAPHIC REPRESENTATION OF THERMAL CHANGES IN CEMENT WHILE SETTING.

Reading this the author was led to take up again certain studies of setting which had been made some years before, in which the resistance to penetration by glass rods was observed, and the resistance to withdrawal of glass threads progressively acted upon by the salts and compounds formed in the paste and operating during the setting process. It seemed to the writer that the holding power of newly formed salts upon glass might be progressively observed. Also it seemed then that the testing of the surface by wire points showed a lack of effectiveness in determining set in colloids and crystallo-colloidal binding agents. Penetration along a plane similar to shear by a knife blade should give better results than mere resistance to rupture of a surface at one point, just as the cutting of metal by a turning tool affords a better test of cohesion than indentation or scratching does.

If several glass rods or pins, .010 or .015 in. in diameter, are driven into soft paste of plaster of cement, and at intervals are tipped forward, they will cut the mass at first considerably; later to a diminishing extent; and finally when the colloids and crystals are both well formed about the pins (a period corresponding with the final set or resistance to the light wire heavily loaded) they snap off sharply and suddenly. Such a combination seemed to give indications of very fine and measureable differences.

Now if a line of such pins were brought up against a glass rod which had been smoked, markings on it would be secured, making a record showing relatively the resistance to penetration.

It seemed that this afforded a means of operating a graphic and chronological method, and the author has made many models of apparatus for such a purpose by making simple adaptations of things at hand till the present model was developed and put lately into this final form by Messrs. Schneider Bros., of Jersey City, the gifted mechanicians who are known all over the world for the simplicity and beauty of their work on scientific instruments.

I will explain in as few words as possible the operation of this instrument shown in Fig. 5. It consists of a spiral shaft, *H* operated by clockwork, giving two speeds, there being a shifting lever *L* for a speed of 1-in. an hour and another speed of double that. It can also be operated by hand through a knurled head at one end. This screw *H* carries a moving finger *F* projecting over a rectangular paste mold 1 in. x 1 in. x 8 in. *C*. The finger moves forward and strikes successively the glass pins *P*

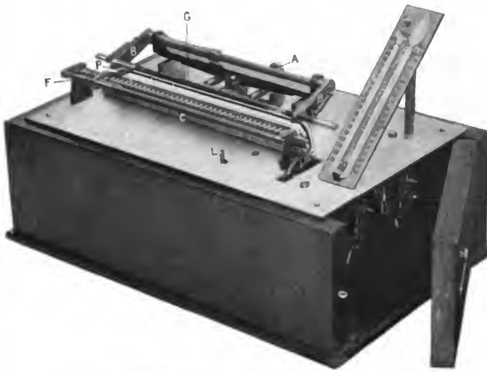


FIG. 5—THE McKENNA CHRONOGRAPHIC RECORD.

This apparatus records the set of cements by breaking at definite intervals pins stuck in the paste. The set is measured by the lateral movement of the pins and is automatically recorded on a smoked glass rod.

inserted deeply into the paste and projecting vertically from it in one line. As each glass pin bends forward it bears against a smoked glass rod and traces its path until where after a distinct resistance is attained, it snaps off. Back of this is an adjusting frame to carry the glass rod, and this can be brought forward very delicately, or drawn back, by the aid of a fine adjusting screw *A* at the back.

The metal mold is filled with freshly gauged cement and run into place between the screw and the adjusting frame. The glass rod which has been previously smoked and then rubbed clean over one-half of its surface, is inserted in the frame and brought forward over the center of the paste so that against the clean part of its surface these little pins are guided by it as they are inserted. So far as the investigations have gone the author finds that a diameter of .015-in. give strength enough for meeting resistance and at the same time giving a tendency to snap. They are pushed in vertically along the middle line ½-in. apart; the glass rod is drawn back by the screw *A* and the untouched smoked part is turned over so that it can be brought up against the pins by the screw again, ready for any record. Then the clock is started, the finger begins to move, and as it strikes each pin successively it makes the respective record of the resistance to penetration at that point and time. A maximum and minimum thermometer can be attached to the base plate.

When everything is thus arranged the top glass case can be put over it, leaving a small dish of water in the case, and the whole may be left for instance, over night. In the morning the entire record is on the glass rod. Records thus made resemble the markings in Fig. 6. These glass rods, with the records upon them, can be varnished and preserved for examination at any time, or the record can be photographed on sensitive paper and thus preserved.

From plaster of Paris the author obtained a simple record of differences in resistance to penetration. There has not been many opportunities to experiment with varieties of this substance, but it may be expected that the instrument will readily indicate the differences due to changes in percentages of water, catalytic agents, etc.

From Portland cement the first few records already obtained are most interesting. It seems that in every normal Portland cement so far tested there is observable in or about the third hour an indication of a relaxation of the stiffness first obtained and then a resumption of hardening. Comparing these results with those of Gary's thermal studies, it is seen that he observed a marked lowering of temperature at or about the third hour. If we consider again the most modern theories of setting, this can be explained. The cooling effect of course is at the period when salts are going into solution most rapidly.

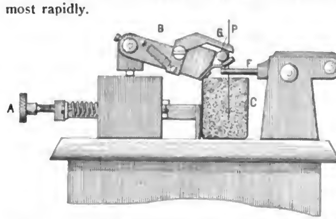


FIG. 5A—SECTIONAL DIAGRAM SHOWING THE ESSENTIAL FEATURES OF THE McKENNA CHRONOGRAPHIC RECORD.

It is well known that if a break occurs in a temperature-solubility curve which is otherwise continuous, it is a proof that the solid substance which is in equilibrium with the solution has passed into another form at the temperature of the break. We

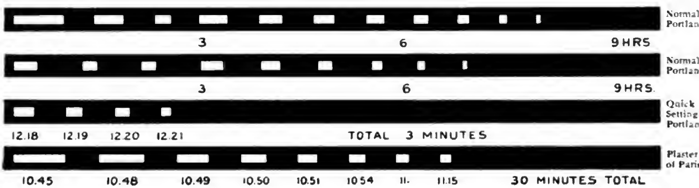


FIG. 6—REPRODUCTION OF SMOKED GLASS RODS.

These indicate the set in the specimen by the distance the pin has traversed before breaking. The record for the plaster of Paris specimen is not symmetrical as to the time, as the legend shows.

have the reverse of this in our record of cohesion, namely: the break in continuity of the marks of increasing cohesion indicates the separating out from a saturated solution of a greater proportion of still another component, and that the water thus freed permeates the colloid and softens it. Later by dessication, by absorption of the water within and further crystallization, cohesion begins to increase and impenetrability and hardness go on. The discovery of this slack period or reverse set explains contradictions experienced in the past in measuring or determining the initial set by the surface penetration system. It probably also will explain anomalies occurring in the practical use of cement during the first hours of gauging fresh cement.

If this observation of change in the order of setting should prove to be universal for cements with the sulphate of lime additament, we may have to observe first *initial set,* then *reverse set,* and lastly *final set,* and distinguish between them in time and character.

It is the author's intention to continue work as opportunity presents on this instrument, which appears to be simple and useful, and in time we may hope to reach a little further in our knowledge of the setting of plasters and cements.

Concrete in Chicago

Concrete construction is more common in the East than in the Middle West, but there promises to be a reversal—an outstripping in point of percentage of concrete buildings to those of other materials, unless there are material gains in the near future. The fact that Chicago leads the cities of the United States in the total number of concrete structures erected, as well as in point of their cost, tells in a word the local effect of the four past cement shows on building operations. What is true of Chicago is true to a great extent of all the Middle West. Yet the early start of the Eastern work and their magnitude as a whole still give the East the preponderance of volume of building in concrete.

Freight Rates on Empty Sacks

One of the factors in the increased use of cement has unquestionably been the reduction in cost afforded by means of the returnable cloth sack. This form of package permits of a saving of very nearly 10c. on every barrel of cement as compared with the non-returnable paper bag. Applied to the annual cement production of the United States, it means a possible saving of seven or eight million dollars a year.

The entire country has benefited by the growth of the cement industry and among those who have reaped the largest benefit are the railroads. In their case, the benefit has been two-fold. Not only have they received the advantages resulting from the development of concrete construction and the incidental economies resulting from the use of the returnable cloth sacks in their own construction work, but they have also reaped the benefit of a large, profitable, and constantly increasing tonnage of cement. Therefore, they owe it to the cement industry to continue in every way in their power to help the growth that has been of so much benefit to them, and it is certainly to be regretted that any railroad organization should take so short-sighted a step as that contemplated by the Western Classification Committee in eliminating the returned rating on empty cement sacks.

Changes in classification have been a favorite method of increasing freight rates. In the case of cement sacks, the Western Classification proposes to abolish the one-half of fourth-class rate, which is now granted to returned empty cement sacks, and make them take the same rating that is applied to brand new sacks, that is to say, second- or third-class. This will have the effect of increasing the freight rates on returned cement sacks in Western Classification territory some three or four hundred per cent., and will place the load on the cement dealer and the cement consumer, the people to whom the country must look for the increased consumption of cement that will justify increased production and increased tonnage for the railroads. This is certainly a step in the wrong direction, and it is greatly to be hoped that the members of the Western Classification Committee will be brought to realize the importance of voting against so mistaken a policy.

EXPORT MARKETS FOR AMERICAN CEMENT

[In a recent paper entitled "A Vital Question of the American Cement Industry," Dr. Otto Schott* refers to the small export trade of American manufacturers as compared with that of European makers of cement. In presenting the following article concerning the opportunity for an increased export trade from the United States, we are indebted to Dr. Schott for the various charts and export statistics published therewith.—EDITORS.]

WHY have American cement manufacturers neglected the opportunity to establish a profitable export trade?

The word opportunity is used advisedly. Year after year American consular and trade reports have called attention to openings in various countries. There is at present a large demand for cement in many non-producing countries and it is constantly increasing. Practically every foreign country that manufacturers cement on a large scale is seeking these markets. South America is an especially inviting field. When the Panama Canal is finished opportunity will be still greater—if foreign manufacturers do not control the situation by getting thoroughly established far in advance of the American manufacturers. The trend is in that direction. American exports have been chiefly experimental. Inferior quality and bad packing have marked these sporadic efforts. But what about intelligent and concerted effort? The more the subject is considered from this point of view the more interesting it becomes.

The problem confronting the American cement manufacturers has been encountered by every other great manufacturing industry. Makers of American agricultural implements solved it by exporting machinery to be sold at lower prices than were demanded in the home market. In several Presidential campaigns preceding and including Cleveland's election, the tariff was the paramount issue. This sale of American products abroad below domestic prices was once a powerful weapon in the hands of the free traders, but it is now regarded as a simple and economical business expedient calculated to sustain production and wages. A further illustration and more recent example is the consolidation of export interests by the independent steel companies in order that they may share in the export trade of the United States Steel Corporation, which reached approximately $70,000,000 in 1911.

To succeed in competition with foreign countries that are manufacturing on a large scale, the American cement manufacturers will need to practice every economy, and chiefly through consolidation of interests represented by a general export company. This would mean the elimination of competitive salesmen and advertising, duplicating of clerical forces, offices and the thousand and one costly details incident to competition among several or many companies. Investigation as to markets and trade requirements could be pursued with a despatch and certainty hardly possible in the case of an individual company. Such a combination would materially influence the situation in the matter of transportation and rates. These are but a few advantages that occur at the moment.

From sources of undoubted authority we have the statement that Germany, after losing this market through the advent of American mills, built up within the short period of two years an export trade that compensates for the decline in her exports to this country. With an annual capacity of 50 millions of barrels and consumption but half that amount, her industry prospers. Of course, this is chiefly due to the Association of Manufacturers,

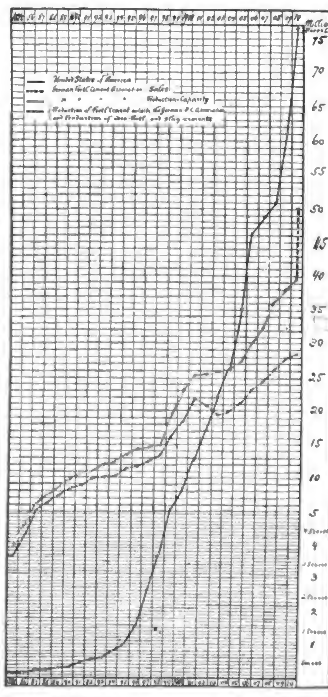


CHART I.—CHART SHOWING CEMENT PRODUCTION AND SALES.

*Consulting Engineer, New York City.

which controls output and prices, but the export trade is regarded as an important feature of the industry, as is the case in England, France and Belgium.

Herewith are published several charts relating to production and export trade in various countries.

Chart I relates to the production of Portland cement in the United States, sales of the German Association and production capacity, the production of companies outside the Association and the production of iron-Portland and slag cements.

Chart II gives the exports of the United States, Germany, England and Belgium.

Chart III covers production and exports in France.

Chart IV gives exports of Germany to European countries and imports from European countries into Germany.

Chart V gives present distances between New York and important export points and the change that will be affected by the operation of the Panama Canal.

France, in 1910, exported 23 per cent of her entire production. England is at present the largest

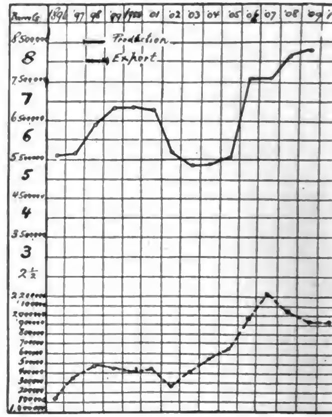


CHART III.—PRODUCTION AND EXPORT IN FRANCE.

exporter, her record for 1910 being 4,400,000 barrels. In the same year Germany exported more than 14 per cent of her production or 4,250,000 barrels. Even little Belgium came within 50,000 barrels of the above figures. The United States is at the foot

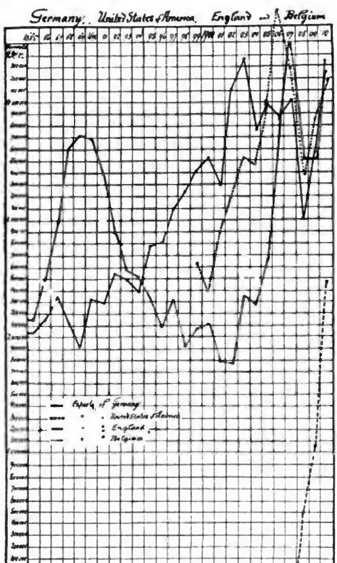


CHART II.—EXPORTS OF THE UNITED STATES, GERMANY, ENGLAND AND BELGIUM.

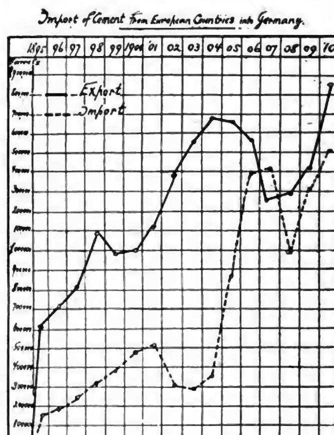


CHART IV.—GERMAN EXPORTS AND IMPORTS.

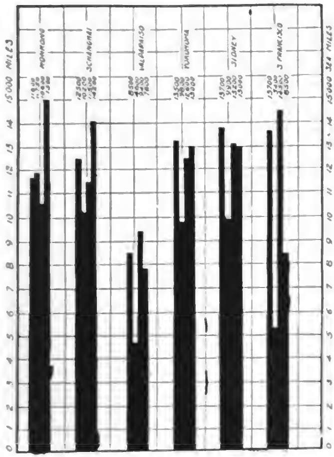


CHART V.—ADVANTAGES OF PANAMA CANAL FOR THE UNITED STATES.

The first line in each group refers to the distance between New York and important export ports.
The second line in each group refers to the distance between New York and important export ports after the opening of the canal.
The third line in each group refers to the distance between Europe (Hamburg) and important export ports now via Suez Canal.
The fourth line refers to the distance between Europe (Hamburg) and important ports via Panama Canal.

of the procession with an export trade (including Panama, which is really domestic consumption) of only 3.4 per cent of her production. Had we reached Germany's percentage our foreign sales would have represented 11,000,000 barrels. It may be said that these percentage comparisons are not logical in view, for example, of the vast difference between 25 and over 70 millions of barrels as represented by Germany and the United States, but matters assume a different aspect when we consider *the corresponding vast consumption in this country and the resources of the foreign territory still to be exploited.* Unquestionably a large export trade could be eventually developed under a well-organized and thoroughly efficient administration representing at least the leading Eastern manufacturers of the United States. Not long ago the export trade of England languished to a degree akin to the situation in this country, but through well directed effort she has become the world's largest exporter of cement.

Thus it would seem that an American exporting company embracing all the large manufacturers of the East would be in position to develop an exceedingly important trade. Cement could be sold under a uniform brand. The sales of such a company would not be affected by good or bad times in this country. The company could do its own banking after the custom of European exporters. It could command the services of salesmen familiar with the language and business customs of the foreign country. To meet packing and shipping requirements, an important consideration as it has developed, the company could manufacture its own barrels or casks. It could establish its own warehouses and terminals, and would be in position to take advantage of every economy in carrying or freight charges. In brief, an exporting association or company of this nature could adopt with advantage the essential features of the German cartell system. In the South German Association, which represents thirty companies, sales are made from a single place. There is avoided unhealthy competition, which gives opportunity for concentration upon the development of the mills and markets of the Association. In recognition of the good results of consolidations of this character, the German Government is entirely favorable to their organization and operation. Similar effort confined to the development of foreign trade could certainly be made a profitable enterprise for American manufacturers of Portland cement if undertaken before foreign competitors become more firmly entrenched.

Interesting Use of Concrete in Substructure Work

In the building of the Seaman's Church Institute, New York, the character of the soil and the heavy column loads necessitate carrying the foundations to rock, which, with the deep footings, the large amount of water found near the surface, the difficult materials and numerous obstructions, would be a difficult and costly undertaking by ordinary methods. It was therefore decided to inclose the lot by a retaining wall carried down to rock in advance of other operations and thus forming at once the foundations for the wall columns and a permanent cofferdam which, being unwatered, will permit the general excavations to be completed and foundations for the interior of the columns to be carried to rock without difficulty.

The sub-basement floor will be of reinforced concrete laid on or near the surface of the rock and covered with waterproofing carried under the column bases and extended continuously over the inner faces of the outer walls. The entire excavation will thus be lined with a continuous mass of concrete proportioned to resist external pressure, exclude ground water, carry a considerable portion of the superstructure and facilitate the work on the interior foundations.

The operation is described and illustrated in detail in *Engineering Record* of December 23.

New Cement Works in Austria-Hungary

There was formed, on December 7, in Cracow, Austria-Hungary, a cement company, with a fully paid up share capital of about $625,000, to manufacture cement in Siersza. Operations will begin about July next.

CEMENT AND CONCRETE CONSTRUCTION IN FOREIGN COUNTRIES

THE Daily Consular and Trade Reports for January 3 contains an interesting summary of the situation in various countries as it pertains to the use of cement. These reports show that in many places there is opportunity for the American manufacturer of concrete machinery to develop trade, even though the cement manufacturer may find transportation costs and tariffs prohibitive. They also show that in all parts of the world cement is gaining favor at the expense of other materials in recognition of its superior structural worth. The following are extracts from the report:

Germany

[From Consul General Robt. P. Skinner, Hamburg.]

In the city of Hamburg, the nature of the soil is such that, aside from the restrictions fixed by law upon the height of buildings, no very tall structures can be erected, and the number having as many as ten floors is small indeed. Reinforced concrete is extensively used in large buildings, although in many cases the steel frames common to the United States, with a filling of sandstone and ornamental brick, are employed.

The walls of brick structures are given a coat of Portland cement stucco which is afterwards painted. The cement is put on from the top of the building downward, the scaffolding being removed with the completion of the work.

Ornamental work for reinforced concrete buildings is either made upon the premises by means of wooden molds or, as often happens, the decorative figures are carved by stonecutters from walls made sufficiently thick to admit of this treatment.

A prominent engineer of Hamburg reports that concrete blocks, introduced into Germany a few years ago, were unsatisfactory as they proved to be more expensive than brick, to which the German people are partial. It will be readily comprehended that when a building is intended to be covered with cement a much cheaper grade of bricks can be used than would be employed in the ordinary American residence.

SLAG BRICKS—VARIATION OF DESIGNS: A brick is manufactured in this country from cement and slag, which is very light in weight but possesses sufficient sustaining power. It is used extensively for the interior walls of office buildings. Sometimes these bricks are made hollow to allow of their use as conduits for pipes and wires. They are offered to-day (October 25) at $7.14 per thousand, and an excellent quality of clay brick can be had for the same price, delivered on the building lot. In setting in partition walls, slabs of slag concrete 3 ft. 6 in. long, 1 ft. wide, and 2 in. thick are used, these being tongued and grooved on the edges, so that the fresh cement which holds them together constitutes a solid sustaining rod both horizontally and perpendicularly. These slabs cost 54 cents per 1.2 sq. yd. set in the wall.

There seems to be little chance of introducing American concrete molds and tamping machines, owing to the opposition to uniformity on the part of builders. One Hamburg firm manufactures a variety of concrete sills, water tables, caps, paving slabs, and cornice and arch stones, but in nearly all cases these are made according to designs of the architect. Special wooden molds are constructed and the pressing is accomplished by hydraulic machinery. Some years ago this firm attempted to market a concrete brick, but in order to compete with ordinary brick in price the product was necessarily of so inferior a quality as to be condemned by the building authorities and was given up. This was also the case in the manufacture of sewer pipe, which could not compete with ordinary clay pipe.

Reinforcing materials other than bar iron, which is most generally used, are covered by patents in Germany and are high in price. Quantities of these materials are exported, but as they are included among "Other goods manufactured of iron" in official statistics, there is no record of the amount shipped to foreign countries. Samples of American reinforcing materials were shown to a number of firms, which expressed the opinion that the designs might infringe upon German patents. There would be no market in this country, in any event for metal laths, as in Germany plaster is applied to the dividing wall itself.

LIGHT CONCRETE ROOFS: The popular German roofing materials are tiling and slate. One engineer consulted suggested that a self-centering reinforcement of American production might be sold in Germany for the manufacture of light concrete roofs if not too costly. While the firms seen have given little encouragement to the American manufacturers of these materials, I am nevertheless inclined to believe that a thoroughly competent American agent on the ground might obtain some business, but attempts to accomplish the same result by correspondence would probably result in failure.

Hamburg builders of reinforced concrete structures work as rapidly, perhaps, as American builders after the foundations are completed, these latter in Hamburg consisting of piles driven closely together and covered with a thick floor of concrete. One local firm erected a fish market in Altona on a plot 20.10 by 37.04 meters (65.94 by 121.52 ft.), three stories in height with an arched roof, in 60 days, the entire structure being made of reinforced concrete.

Italy

[From Consul Frank Deedmeyer, Leghorn.]

In the immediate vicinity of Leghorn is found a cement rock of high value, the geological conditions corresponding with those found in the Boulogne-sur-Mer quarries. The location of the quarries is about 5 miles from the city and the supply is practically inexhaustible. These quarries have been leased for a term of years by a corporation called Cementeria Italiana, with offices at Leghorn. This concern now manufactures annually about 60,000 metric tons (metric ton = 2,204.6 lb.) of a high-class hydraulic cement of the Portland type. The cost of delivering the rock at the factory, including the royalty paid the owner of the quarries, is 55 cts. per ton. The finished product is sold, f. o. b. Leghorn, at $10.60 per metric ton. Most of this cement is used in Italy, although some is exported to Egypt and Turkey. It is employed in the construction of submarine structures, buildings, floors, and sidewalks, and for tiling. The machinery in this local factory is chiefly of Italian make, but some was bought in Germany.

Russia

[From Consul John H. Grout, Odessa.]

Since the beginning of 1911 there has been a revival of building operations not only in Odessa

*Very similar slabs are being used by the Bush Terminal Co. in their industrial development, New York.

and other important centers of this consular district, but all over European Russia.

As regards construction work into which cement enters, it is more abundant than for a considerable period past. So extensive is it that Russian cement works are hardly able to supply the demand, and builders are turning to points outside of Russia for supplies. Taking advantage of this state of affairs, which is likely to continue for some time, it is alleged that the Russian cement manufacturers are seriously considering raising prices. According to information received by the Odessa Bourse, the cement factories in southern Russia have formed a syndicate to be known as the Russian Cement Trading Co., which organization will have charge of and regulate all sales of cement. Any factory desiring to do an independent business will have to compete with the syndicate.

These facts have necessitated the consideration of means to prevent an advance in prices of cement, thus protecting the Russian buyer. The bourse committee of Novorossysk, being the nearest to the chief center of Russian cement production, has requested the various bourse committees of other cities of Russia to bring up for discussion the question of what measures ought to be taken to prevent increased prices of cement. It is expected that one recommendation to be adopted will be that of applying to the Minister of Finance, asking him temporarily to remit or diminish duties upon foreign cement.

This consulate has been informed that, owing to the superior quality of certain grades of Russian cement, many contracts for its exportation are in force. These contracts have to be filled, and we thus have the condition presented that, while home demands for cement are pressing, engagements require its exportation to a certain extent. This, of course, reduces the home supply.

There is in process of construction by the Russian Government at Cronstadt a graving dock that, when finished, will probably be the largest of its kind in the world. The amount of cement needed for this dock alone will be enormous and impossible to supply from Russian factories.

Austria

[*From Consul Joseph I. Brittain, Prague, Bohemia.*]

An investigation of trade conditions points to the advisability of American manufacturers of concrete mixers making a practical effort to get in communication with some of the leading Prague dealers in these machines. The effort will not cost much and may produce good results.

There has been a large amount of concrete work done in and about Prague within the past few years, such as building locks, dams, retaining walls and various structures having in part concrete construction. Where extensive work is being conducted the mixers are operated by electricity, but where the contract is small they are manipulated by hand. Much of the mixing is also done by hand without the use of any machines, as labor is poorly paid here, and usually there is more labor than employment. Machinists are paid 10 to 12 cts. per hour, with 12 hours' work; carpenters 12 cts. an hour, with 10 hours' work; masons 12 cts. an hour; ordinary laborers from 40 to 65 cts. a day. Women are largely employed by masons and plasterers in the construction of buildings. These women usually mix the mortar, sift the sand, and carry mortar and frequently bricks to the masons. The concrete mixers mostly in use here are imported from Germany.

In corresponding with the leading contractors whose names are forwarded (and obtainable from the Bureau of Manufactures), letters must be written in German or Bohemian, and prices given in crowns. One crown equals $0.203.

Turkey

[*From Consul General G. Bie Ravendal, Constantinople.*]

Cement forms an important item of Turkey's purchases from France, Austria-Hungary, Germany, Russia, United Kingdom, Belgium and Greece.

An English cement, known as the Hollick brand, is handled by a local company that is under contract to sell at least 2,500 tons a year. The price of this brand is 51 francs ($9.843) per ton of 1,000 kilos (1 kilo = 2.2 lb.) sold in sacks. When sold in barrels (1 bbl. = 180 kilos) the price is 48 francs ($9.264) per ton. Another English cement is the Johnson brand, whose agents in Constantinople dispose of about 500 tons annually. The price is 49 francs ($9.457) per ton in barrels.

Austrian cement, known as the Beochiner cement, from Budapest sells to the exent of about 7,000 tons a year. The price is 46 francs ($8.878) per ton, sacks included. The price in barrels is 43 francs ($8.229) per ton, barrels included in weight. About 3,000 tons of Lankenfelt cement from Trieste are sold each year at the same prices as the brand just mentioned.

Other European Cements: The largest cement exporters into Turkey are the Germans, due principally to the extensive use of their product in the construction of the German railroads in Anatolia. The Westphalia Cement Syndicate sells about 10,000 tons of cement to Turkey. The price, in sacks of 50 kilos each, is 43 francs ($8.299) per ton, an allowance of 6 cts. each being made upon the return of the sacks. When sold in barrels the price is 46½ francs ($8.975) per ton. The increase in price of barrel cement is due to the high cost of wood in Germany.

France at first held complete control of the Turkish cement market, but it has lost its popularity.

The Russian cement is known as Gelenjig. It is almost a natural cement, very good in quality. About 3,000 tons per year are disposed of. The price is 38 francs ($7.334) per ton in sacks cost of sacks not included. The price in barrels (180 kilos) is 44 francs ($8.492) per ton.

The Greek cement sold in Constantinople is the Tinos cement made in Piræus. This is used as a matter of patriotism by the Greek architects of Constantinople of whom there are a great number. About 1,000 tons are sold annually. The price of this cement is 46 francs ($8.878) per ton in sacks, cost of sacks not included.

A Belgian cement is also in the market, having a sale of about 3,000 tons per year. The cost of this cement, sold in barrels, is 45 francs ($8.685) per ton. The only white Portland cement used at present is Ciment Grabie. It sells for 54 francs ($10.422) per ton, in sacks.

Due note should be taken of the fact that all prices quoted above are c. i. f. Constantinople.

An Expanding Market: Cement is used in Turkey for concrete work, stairs, and tiles, and for decorative purposes. Foundations are now laid in iron and cement to resist earthquake shocks. Buildings are generally faced with a lime and sand mixture, although sometimes ordinary black cement is used, after which it is lime washed.

Ten years ago no Portland cement was used in Turkey. Since then there has been a continuous growth in its employment until in Constantinople alone there has been a 30 per cent yearly increase in the use of cement. After careful study an expert estimates that 130,000 tons of cement can be utilized

in Turkey at present; of this quantity only about 40,000 tons are supplied by Europe. There is a splendid opportunity for American cement to enter the local market if in selling price it can compete with the products of other countries. The question of credit must also be taken into consideration. English companies give the minimum credit of three months, while Greek firms allow the maximum credit of eight months; others extend a credit varying between four and eight months. From this it will be seen that cash-with-order transactions are out of the question.

Because of building demands in European countries and the need of cement for their respective local markets the price of cement in Turkey is going up. This ought to form an opening wedge for American manufacturers. The market for white Portland cement is very good, owing to the existence of but one competitor, and that one of cheap quality.

CONCRETE BUILDINGS IN ASIA MINOR. Three years ago a local firm, through the aid of this consulate, imported a small plant of American machinery for making concrete building blocks. It was a new and untried enterprise in this part of the world. The fact that the manufacturers of the machines, contrary to the too common practice, gave prices f. o. b. Trebizond, was an important factor in securing the order.

In the beginning people were rather skeptical about this new sort of building material, and the new enterprise had to meet the difficulties inevitable to every innovation, but gradually prejudice has disappeared and now Trebizond has several very creditable buildings made of American concrete blocks, and the ornamental blocks are being employed in a number of other buildings constructed of stone and brick. The new Bank of Athens building, centrally located on the most important business street, was built by this firm and is the best bank building in the city and a good advertisement for the concrete construction.

The business has proved so satisfactory that the firm has opened a branch concrete-block factory at Samsun, also with American machinery. There it is expected that a good business will be done, owing to the fact that the Samsun-Sivas railroad has been begun and an unusual amount of building is going on.

It is to be hoped and expected that this pioneer success will lead to more American business in this and other lines. American manufacturers should not despise small orders from a country like this where machinery is little known and every new machine is, in a way, a missionary of modern methods.

Zanzib r

[From Consul Alexander W. Weddell.]

A certain quantity of English, Belgian, German, and Norwegian cement is brought into Zanzibar for local consumption and for distribution to the mainland. The greater quantity used is of English manufacture and the largest single local consumer is the Department of Public Works. A good deal of cement is being used on the two German railways, which are being extended, leading out of Tanga and Dar-es-Salaam, and the Public Works Department of the East Africa Protectorate is also a consumer. A local dealer has expressed the fear that on account of greater distance and consequently higher freight rates American cement could not compete with the European products. In quoting terms it would seem almost essential that they should read c. i. f. Zanzibar, or Mombasa, or Dar-es-Salaam, as do the prices of the European producer.

At all the coast ports cargo is unloaded by means of lighters, and is often exposed, especially during the rainy season, to bad weather. The Belgian cement is received in wooden casks, tin-lined, the German and English in iron drums, and the Norwegian in casks, lined with a thick waterproof paper.

British South Africa

[From Consul General R. Guenther, Cape Town.]

The total importations of cement into the Provinces of the Cape of Good Hope and into British South Africa for the year ended December 31, 1910, by countries of origin, were as follows:

Imported from—	Via Cape of Good Hope.		Via all ports.	
	Pounds.	Value.	Pounds.	Value.
United Kingdom....	57,954,127	$163,407	149,575,341	$446,409
Belgium..........	4,210,000	10,380	30,130,744	94,702
Denmark..........	79 600	214	2,827,600	8,867
Germany..........	884,000	2 346	12,661,044	49,521
Norway...........	160,000	389	160,000	389
Sweden...........	1 200,000	2,773	1,200,000	2,774
United States.......	12,000	219	20 000	277
Total..........	64,499,727	$179,728	196,574,729	$602,939

The landed cost and the selling price of cement at Cape Town are approximately as follows: British, costs $2.43, sells $2.67; Belgium, German and Swedish, costs $2.13, sells $2.37. Portland cement is being manufactured in the Transvaal, but owing to the unusual demand for building materials, growing out of the location of the executive branch of the Government in Pretoria, the supply available from South African sources is quite inadequate. White Portland cement is practically unknown here.

A special rate of $3.04 per ton of 2,240 lb., from London (England) to Cape Town, is allowed on cement of British origin.

China

[From Vice-Consul T. Percivale Thompson, Foochow.]

The consumption of Portland cement in the Foochow district is so small as to be almost negligible. There are few buildings of foreign or semi-foreign architecture here and no cement walks. Where the streets are paved it is with long, flat flags.

It is possible that there may be an opening for white Portland cement. Chinese building, such as temples, guild houses and some of the larger shops and residences are highly ornamented with stucco designs and figures. This is particularly true of the roofs, which are usually concave and of tile fastened with clay, the ridge pole and eaves being much embellished. If white Portland cement could be furnished at a sufficiently low price there might be an opening; but the local Chinese are extremely conservative, so it is difficult to say whether or not it would be possible to successfully introduce such a product.

There is a big cement works at Green Island, near Hongkong, as well as two or three others in northern and central China. Consequently, there is a good deal of competition in the ordinary lines of cement.

Burma

[From Consul M. K. Moorhead, Rangoon.]

Cement is used to a considerable extent in Burma. Modern steel-framed buildings having brick

walls with cement facings are now being erected in Rangoon. The Public Works Department of the Government of Burma employs a great deal of cement in the construction of public buildings, bridge work, etc. The Rangoon Port Trust is engaged in the construction of a large retaining wall, for which much cement will be needed during the next five years.

There was no cement imported from the United States in 1910, nor during any of the last five years. The selling price of cement in Rangoon is $2 to $2.50 per cask of 400 lb., gross weight. American cement would have to be landed in Rangoon for about $1.60 per cask in order to secure a footing. It is absolutely essential for American producers to quote c. i. f. prices Rangoon.

Siam

[*From Vice-Consul General C. C. Hansen, Bangkok.*]

Concrete construction is extensively employed by the Siamese Public Works Department and private concerns for foundations of large public buildings, walls of canal locks and sewers, in the construction of bridges, and for many other purposes, but the cement needed is not manufactured locally, although abundant material for its production is found not far from Bangkok. The customs returns show a steady increase in the amount of cement imported yearly, the receipts for the fiscal years 1907-8, 1908-9, and for 1909-10 having been valued at $158,273, $140,069, and $223,428, respectively.

Philippine Islands

[*From Consul General George E. Anderson, Hongkong.*]

Apparently Hongkong has regained its hold upon the cement trade of the Philippines at the expense of American cement exporters. The imports of cement into the islands in the fiscal year 1911 show a large increase in the total receipts, but a decided decrease in cargoes from the United States.

The enactment of the tariff law which admitted American cement free of duty into the islands was followed by a gain in imports of American cement. The imports of cement into the Philippines for commercial, as distinct from governmental purposes, were 28,418 metric tons, valued at $331,143 in 1908, the United States having no part whatever in the trade. In 1909 the imports were 25,040 metric tons, valued at $247,425, of which the United States supplied less than $300 worth. In 1910 the commercial imports were valued at $416,815 and included 42,776 metric tons, of which 9,227 tons, valued at $103,078, were from the United States.

This increase in the total imports was more apparent than real, for the reason that the fiscal year 1910 was the first year in which imports of cement for governmental use were included in the commercial import figures.

Trade Fluctuations—Increasing Use of Cement: The increase from the United States, however, was real and represented an effort on the part of American exporters to get trade that theretofore had been largely in control of the Hongkong cement manufacturers in competition with the cement factory at Haifong, in Indo-China, and a Chinese Government-aided factory near Canton. In the fiscal year 1911 the total imports of cement into the islands amounted to 55,480 metric tons, valued at $526,456, an increase of 12,704 metric tons, valued at $109,641. The purchases from the United States, however, reached a value of only $71,436, as compared with $103,078 the year before, while imports from other countries increased from $313,737 to $455,020. While some small shipments continue to come from Germany, Belgium, China, and other countries, the greater portion of the trade in the islands is now divided between the Hongkong concern and the Indo-China factory, Hongkong having much the larger portion.

In connection with the figures of the fiscal year 1911, which show a large general advance in imports of cement over previous years, it is noted that, while most of the increase is due to the building of bridges, municipal and other structures, and various public docks and similar works, there has been a notable increase in sales of cement to Filipinos for general purposes. The use of concrete by Filipinos and Chinese in the islands is greatly on the increase. Even in nipa houses the posts are being placed in concrete foundations nowadays. It is likely, therefore, that trade in the future will continue to expand rapidly.

New Zealand

[*From Vice-Consul General Henry D. Baker on special service.*]

The New Zealand Federation of Waterside Workers has served notice that after January 1, 1912, its members will decline to handle any lime or cement not contained in dust-proof bags or casks. The secretary of the union explains that a long notice has been given in order that local manufacturers of lime and cement might have ample time to make preparations for putting cement and lime up in paper-lined bags. It is claimed that handling of cement as now put up in New Zealand creates clouds of dust, which is bad for the health of the men and ruinous to their clothes. No objection is had to imported cement that comes in paper-lined casks.

In view of the position taken by the local Waterside Workers' Union, the local manufacturers of cement, to avert serious labor troubles after the first of next year, are now making efforts to secure paper-lined bags which will be satisfactory to the waterside workers. One leading local manufacturer recently cabled to the United States for samples of ordinary hemp bags lined with corugated paper, which were quoted at about $30 per thousand. Unfortunately, when these samples arrived they had been folded and packed in such a way that they were badly crushed and leaky, and when submitted to the officials of the New Zealand Federation of Waterside Workers failed to meet their approval. It is hoped that other samples in better condition will be received soon and meet with the approval of the union: if so, large imports from the United States will follow. One firm has an initial order for 50,000 bags awaiting the first manufacturer who can submit satisfactory samples.

Market for Dust-Proof Bags—Growing Use of Cement: Not only in New Zealand, but also in Australia, paper-lined bags are becoming a necessity for the local cement trade, and recently at Melbourne a serious strike was caused at the wharves through refusal to handle dusty bags of cement. There seems, therefore, a prospect of a large trade in the future in dust-proof bags for cement throughout Australasia, of which American manufacturers would do well to take prompt advantage. The bags should be of a size sufficient to hold 190 lb. Locally made cement is always put up in such bags, not casks or barrels, as is imported cement. The Indian jute bags at present in use are coarse and leaky.

The demand for cement for purposes of concrete construction is steadily increasing. Concrete is rapidly growing in favor as a building material in

New Zealand cities, as it is recognized as resisting earthquake shocks much better than brick, while as regards fire insurance premiums it has a big advantage over wood. For instance, on wooden houses close together in Wellington the rate of insurance is 8s. 9d. ($2.13) on each £100 ($486), while for houses of concrete construction the premiums are only 3s. 4d. (81 cts.) on each £100. Earthquakes occur with considerable frequency in New Zealand, but no damage has so far been noticed in the case of reinforced concrete. In country districts farmers are constantly making more extensive use of concrete for silos, drains, drinking troughs, etc. In railway construction, bridges, and harbor improvement immense quantities of cement are required for concrete work. The Auckland harbor works alone are now requiring cement to be delivered at the rate of 6,000 tons a year for six years. At Westport, on the west coast of the South Island, ferro concrete piles are being driven as foundations for a lagoon dock which will cost about $650,000. At Port Chalmers, the port of Dunedin, there are to be large expenditures in the future to improve the harbor accommodation for shipping, and much concrete will be required. At Wellington a recent attempt to build a large sea wall ended in failure, owing to the difficulty of getting the concrete to adhere at a great depth under the water.

New Zealand Cement Industry: The New Zealand cement industry has been assuming considerable proportions in recent years. There are now 20 lime and cement works in the Dominion, employing about 300 persons, and improvements are being carried out which will largely increase the present local facilities for the manufacture of cement.

Notwithstanding the large domestic production of cement in New Zealand, 131,675 barrels, having a value of £52,496 ($255,471), were imported during 1910, nearly all of it from England. The local cement-making industry is protected by a duty of 2 shillings (48.6 cts.) per barrel. There is also a preferential surtax of 2 shillings per barrel on imports of cement from outside the British Empire, so that in the case of American cement the import duty is double that on English cement and practically prohibits any cement from the United States, except plaster of Paris (admitted free from all countries), from obtaining a market in New Zealand. The present price of Portland cement in New Zealand, wholesale and duty paid, is $2.82 per barrel, and of American plaster of Paris, $3.12 per barrel.

Cement and Concrete Machinery: While it is impossible, apparently, for American manufacturers of cement to surmount tariff disadvantages in this Dominion, and so secure a market here for their products, yet the rapidly expanding uses of cement offer an encouraging prospect to American manufacturers of cement and concrete making machinery. There is already quite an extensive demand for American appliances, especially for crushers, conveyors, and rotary kilns. The use of American concrete mixers is, however, not so extensive as it ought to be, and at present locally made machines are considered in most cases to give sufficient satisfaction.

A great many molds and block machines are now being sold to New Zealand farmers and other persons in rural districts to enable them to make extensive use of concrete. An American molding machine, selling for $30 upward, is especially popular, and at the different agricultural shows where it has been exhibited it has attracted much attention. By use of this machine two men can make up to 50 silo blocks (equal to 1,000 bricks) in one day. Cement is now used for a great variety of purposes on New Zealand farms. On the New Zealand Government railways large numbers of concrete pipes are now being molded, to be used in making subterranean escapes for water where the lines may be otherwise threatened with washouts.

The city of Christchurch has made an especially large use of concrete in public works and private buildings, and the city by-laws (a copy of which is on file in the Bureau of Manufactures) contain some comprehensive regulations respecting the use of reinforced concrete.

Chile

[*From Consul Alfred A. Winslow, Valparaiso.*]

The use of cement in Chile has greatly increased during the past five years, and from present indications the consumption of cement will double during the next half decade. In 1906 the imports of cement into Chile amounted to 50,000 tons, of which England furnished 26 per cent, Germany 56 per cent, and the United States 3 per cent, while in 1910 the imports totaled 80,000 tons, of which Germany supplied 60 per cent, England 20 per cent, and the United States 12 per cent.

In 1908 a company was organized in Chile with a capital of $681,310 United States gold for the manufacture of cement in this country, and a plant was erected at Calera, about 30 miles inland from Valparaiso on the railway to Santiago. Early in 1909 the production of cement was begun; 81,571 barrels, or 15,335 tons, of cement were manufactured during that year, and 141,696 barrels, or 26,638 tons, in 1910.

The cement manufactured in this country is of a fair grade and has been accepted by the Government engineers as suitable for public works. As the capacity of the Calera plant is 200,000 barrels, or 37,500 tons, per annum, it can be seen that there will be a growing demand for cement imports into Chile for some time to come. It would seem that American interests might secure a greater portion of this business. The principal difficulty so far has been the price. American Portland cement stands well, but not enough so to overcome the higher prices charged, except in cases where quality is a prime factor.

The lists of names that accompanied several of the above reports may be obtained from the Bureau of Manufactures.

Fireproof Mortar

In erecting the brickwork for chimneys, where fireproof bricks are used, refractory mortar of the same composition should also be used. It is best to get both the mortar and bricks from the same plant so as to assure uniformity of material. In general a mortar composed of finely ground fireproof brick and clay will be most satisfactory. The finer the mortar is ground the closer will be the contact between mortar and bricks and the longer will be the life of the chimney. Coarse grained mortar should never be used for the opposite reason.—*Tonindustrie Zeitung.*

Moving Pictures

Motion pictures, says the *Canadian Engineer*, were used to illustrate work on placing underground conduits and construction work incidental to this in a recent lecture to the Canadian Society of Civil Engineers. This is the first time that motion pictures have been used for such purposes. There is, no doubt, a wide field for their use along these lines, for they afford a most excellent means of showing methods of construction and design.

THE FUTURE OF NATURAL CEMENT

THE rise and fall of the natural cement industry in the United States is shown by Ernest F. Burchard, of the United States Geological Survey, in "The Cement Industry in 1910," recently issued by the Survey as an advance chapter of "Mineral Resources for 1910." A dozen years ago the production of natural cement was nearly 10,000,000 barrels; last year it was but 1,139,239 barrels. It seems that it is a case of the survival of the fittest and Portland cement has largely displaced natural cement. The following table tells the story:

PRODUCTION OF PORTLAND AND NATURAL CEMENT IN THE UNITED STATES, 1899-1910 (IN BARRELS).

Year	Portland cement.	Natural cement.
1899	5,652,266	9,868,179
1901	12,711,225	7,084,823
1903	22,342,973	7,030,271
1905	35,246,812	4,473,049
1907	48,785,390	2,887,700
1909	64,991,431	1,537,688
1910	76,549,951	1,139,239

Natural cements differ from Portland cements in the following important particulars:

Natural cements are not made from carefully prepared and finely ground artificial mixtures, but from natural limestone rock.

Natural cements are burned at a lower temperature than Portland, the mass in the kiln never being heated high enough even to approach the fusing or clinkering point.

Natural cements, after burning and grinding, are usually yellow to brown in color and light in weight, having a specific gravity of 2.7 to 3.1—that is, the cements weigh from 2.7 to 3.1 times the weight of water. Portland cement is commonly blue to gray in color and heavier, its specific gravity ranging from 3 to 3.2.

Natural cements set more rapidly than Portland cement, but do not attain so high tensile strength.

Portland cement is a definite product, its percentages of lime, silica, alumina, and iron oxide varying only between narrow limits, while brands of natural cements vary greatly in composition.

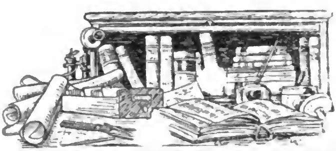
The future of the natural-cement industry, according to Mr. Burchard, seems to depend on means of improvement in the manufacture of the cement, chemically or by better mechanical devices, whereby it may be brought nearer to the specifications for high-grade Portland cement. The decline in the use of natural cement has been due principally to the greater tensile strength of Portland cement. At long periods, as shown by many records, the two cements in sand mortars show practically equal results.

Mr. Burchard's statement of the differences between natural and Portland cements omits the most important of all; that is,—the low lime contents of the natural cement; he also implies lack of care in its preparation. The statement that natural cements set more rapidly than Portland cement, but do not obtain so high a tensile strength, is probably not correct, as long time tests show that natural cements may develop greater strength than Portland.

It is a recognized fact among engineers and chemists that Portland cement, on hydration, forms a large amount of calcium hyurate—a very unstable and easy decomposible salt. To overcome this, the use of puzzolanic material, ground with the cement, is to some extent advocated, the thought being that the added silica would combine with the excess lime. The results obtained by this method, however, are far from being as satisfactory as it was thought they would be. In this country the use of puzzolanic material with Portland cement has been largely confined to the West, where puzzolanic deposits are plentiful. We would point out, however, that in the territory east of the Mississippi, engineers have at hand in natural cements a material in every way superior to puzzolan as an addition to Portland cement. Nor is such a use experimental, for, while it may not be generally known, blended cements (consisting of about 3 parts of natural cement and one part Portland cement) were especially prepared and used in large quantities in connection with the New York subway, their use being chiefly in conjunction with sewers, where they were specified by reason of the greater impermeability and resistance of their mortars to the attack of sewer gases and the chemicals frequently found in solution in sewage. It is unfortunate that fear of the charge of adulteration has deterred Portland cement manufacturers from the making and putting on the market of mixed or blended cements, which, from an engineering standpoint, are in some ways more satisfactory for most purposes than Portland cement alone. It is impossible to form a homogeneous mixture on the work, and to be effective, the mixing or blending should take place at the point of manufacture.

Blended cements will probably make greater progress in the West, where a decided saving in cost is effected by their use, due to the high price of Portland cement. In the east, however, such cements, when properly made, will cost more than ordinary Portlands, as their preparation is more expensive, but their decided advantages would warrant their employment—even at a greater cost—in all work exposed to the injurious action of sea-waters or waters containing sulphuric and other acids, which might attack Portland cements.

After a long and bitter fight by the clay interests the Kansas City Council has agreed to accept concrete pipe in competition with the clay product, and the first concrete pipe was laid in Kansas City, December 23, 1911. It is reported that the competition has already resulted in a reduction of from twenty to forty per cent. in the price of clay pipe.



CONSULTATION

210. The "Colloidal Theory"

"Two years ago we heard continually about 'colloidal theory.' The technical papers were full of 'mineral glue' talk. To-day this seems to have quieted down to a remarkable degree, and we hear nothing further of it. What is the present status of the 'colloidal theory'."

210. Discussion

The *Engineering Record,* in discussing the expansion and contraction of concrete while setting says that colloids in cement were discussed frequently by the late Wilhelm Michaelis and his perseverance in talking about the subject, whether or no people were desirous of listening, gave it a measure of unpopularity for a time. Those who care to look up the colloidal theory will find an account of it by Edward Godfrey in the *Engineering Record* of Oct. 16, 1909. It is brought up again in connection with the paper by Professor White describing the expansion and contraction of mortar and concrete when wet and dried. This has also been observed in tests at the laboratory of the U. S. Office of Public Roads. Some years ago Dr. A. S. Cushman made many experiments to find the cause of the binding power of certain powdered rocks and later that of the plasticity of clay. This was traced to colloids and could be destroyed by high temperature. If the changes of volume of concrete have a similar colloidal cause, baking will probably destroy it, and a ready means of testing the colloidal theory is therefore available.

217. End Anchorage of Rods in Flat Slab Construction

"How are the floor reinforcing rods anchored at the wall columns of the flat slab construction?"

217. Discussion by Louis F. Brayton*

I would consider that in a properly designed building the question of anchoring is not a part of the design any more than it is in any reinforced concrete slab or beam. A slab should be strong enough and properly reinforced to carry itself without depending upon wall anchorage which will cause a negative bend moment in the slab at the wall columns, and also an eccentricity in the columns themselves.

It seems to me that flat slab designs should be followed along the same basis as any other engineering design. A beam or a slab of any ordinary type does not have to be anchored to the wall in order to be strong within itself. Why should a flat slab? Anchorage is always furnished; so is it furnished in a wooden building where the wooden joists are anchored to the brick walls. This is simply because all parts of the building are tied together, and not because the anchorage has anything to do with the strength of the joists.

*Brayton Engineering Co., Portland, Ore.

221. Using Waste Heat from Kilns

"In studying the question of cement manufacture, we are interested in the possibilities of using waste heat from two kilns to dry or pre-heat raw material, or to pre-heat water for boilers. What is the present day opinion of this matter?"

221. Discussion

A recent issue of *Tonindustrie Zeitung,* discusses this question, and presents the accompanying diagram submitted by one of their readers. The sketch shows an intended arrangement, in which the exhaust gases from five kilns, each of about 3,000 cu. ft. capacity, are to be conducted into one large drying chamber and from there to the chimney. The question is, will the operation of the kilns suffer, the same being tapped one after the other at various intervals. The chimney is 100 ft. high, and has an upper diameter of 3.3 ft. The conduits *a* are 2 x 3 ft. cross section and roofed with bricks, while the conduits *b* of the drying chamber are 24 x 20 in. and covered with cast iron plates. Exhaust channel *e* leading to the chimney has an overall diameter of 40 x 40 in. and crosses conduit *a* of kiln *v* at a lower level than the latter.

DIAGRAM SHOWING GERMAN SUGGESTION FOR USE OF WASTE HEAT.

In the opinion of *Tonindustrie Zeitung,* the arrangement seems faulty, since the drying chamber is either hotter or colder, according to the state of the heat in the various kilns. A drying chamber should be uniformily heated, which cannot be done in this arrangement, due to the long road which the exhaust gases must travel and the resulting loss of heat. Moreover the distribution of the gases into four conduits increases the friction between them considerably. It would be better to connect the kilns direct, and lead the gases from kiln 1 to kiln 2, and after kiln 2 is sufficiently hot to kiln 3 and so on to the drying chamber.

224. Cost of Concrete Walls

"I quote from page 204 of your November issue: 'Rough hollow blocks may be had of almost any particular shape from machines in use in almost any cement block factory, and are the cheapest form in which concrete can be built into walls of any height'.

"Blocks are one kind of unit wall construction. Are they the cheapest?"

224. Discussion by Alan P. Wilson*

The question is of interest, and I am fortunate in having some recent data on it. In talking with a contractor who has been using metal forms for the past three seasons, I asked him for some inside information not only as to the cost of handling metal forms, but of placing concrete in walls raised about 20 ft. above grade. This contractor places his concrete exclusively with wheelbarrows, so that the figures he gave are doubly interesting.

He said that after three years experience with metal forms he can mix, form and place concrete in 12-in. walls at 4½ cts. per sq. ft. of wall, or $1.21½ per cu. yd.

On basis of material prices, above mentioned, 1:3:5 concrete containing

1 bbl. cement at $1.50	$1.50
12/27 yd. sand at $1.50	.62
20/27 yd. stone at $1.50	1.10
1 lb. steel at $ .02	.02
Costing in all	$3.24

would make, allowing 1¼ yds. of loose material for each yard of concrete, 28.2 cu. ft. of concrete, at a cost, for materials, of 11.5 cts. per cu. ft.

This would make the cost per square foot of a monolithic wall, 12 in. thick, as follows:

Material	11.5 cts.
Mixing and placing, including necessary staging	3.0 cts.
Forming with metal forms	1.5 cts.
Total cost of wall per sq. ft.	16 cts.

Comparison between a 12-in. monolithic concrete wall and a cement block wall of the same thickness is manifestly absurd, as a monolithic wall only 6 in. thick would be very much stronger and more impervious to wind and water than a 12-in. block wall. The cost per square foot of 6-in. monolithic wall would be as follows:

Material, ½ cu. ft. at 11.5 cts.	5.75 cts.
Mixing and placing	1.50 cts.
Metal forms	1.50 cts.
	8.75 cts.

Some allowance must be made for added cost of staging, but this contractor's experience has been that one-fourth of one cent will amply cover the difference between 12-in and 6-in walls, so that 9 cts. per sq. ft. would amply cover the actual cost of a monolithic concrete wall, on basis of material prices as given.

The figures above given are based on experience on a wide range of work covering a long period. They include every item of expense incidental to the construction of monolithic concrete walls, including mixing, wheeling and spading the concrete, cost of staging, setting up, removing and cleaning the metal forms, transporting the equipment from one job to another, and an allowance for interest upon and depreciation of the value of the equipment.

If a finish coat is applied to the surface of the monolithic wall, it can be given a smooth and uniformly colored finish at a total cost for labor and material not exceeding 2½ cts. per sq. ft. of exposed concrete. The surface left by metal forms of proper design is so smooth, however, that on a wide range of work no surface treatment is required.

*Milwaukee, Wis.

224. Discussion by Milton Dana Morrill.*

We are constructing concrete walls with a mixture proportioned one of cement, two of sand and four of gravel, laid up in 6-in. walls at $5.40 per cu. yd. Cost of materials as follows:

1 cu. yd. gravel	$1.50
½ cu. yd. sand	.60
1¼ bbls. cement	1.50
Erection and removal of steel forms 1 ct. per surface ft. of wall	1.10
Handling concrete by spouting method, per cu. yd.	.70
Cost per cu. yd.	$5.40

One cu. yd. of concrete makes 54 sq. ft. of 6-in. wall. The cost of our walls have been an average of 10 cts. per sq. ft. The logical construction for reinforced concrete is by the poured process, provided form cost can be brought within reason, which has not been possible to the best of our knowledge with the use of wood. Our walls poured in steel forms require no such expense in finishing as is necessary in a rougher wall, or in a wall of concrete blocks. We float up the surfaces with water, or sand and cement upon the removal of the forms while the concrete is green.

The cost of this finish is 1 ct. per sq. ft., which includes the floating and brush coating. The monolithic wall furred on the inside, if climatic conditions demand it, offers not only the best wall which can be built but also the cheapest wall which is possible today. While the monolithic wall contains more concrete than the wall of hollow blocks, a greater amount of cement is necessary per sq. ft. of block walls, as the mixture in the case of blocks must be at least one of cement, to three of sand, whereas one to six makes an ample mixture for a reinforced wall for a two story house, which we are constructing 6 in. in thickness for suburban dwellings.

*Reed & Morrill, Inc., New York.

The form cost as above given, 1 ct. per sq. ft. of wall area, including both sides of walls shows where the saving has been made. Whereas in lumber the form cost varies from 5 to 15 cts., we are constructing at ½ ct. per surface ft. As a fireproof material the monolithic structures have stood the test much better than hollow blocks of any material. This has been illustrated in a number of cases where residences built with poured walls have been gutted by fire, but the walls have stood intact and ready for use again.† In the poured process unskilled labor can be largely employed; whereas with block construction skilled masons are employed for the work.

The economy of the poured concrete wall has been shown in a score of houses built in this vicinity,‡ and the poured construction of reinforced concrete, in the writer's opinion is not only the most substantial, but also the least expensive construction now available.

229. Transverse Reinforcement in Unit Slabs

"Are data available from tests of rectangular reinforced concrete slabs, supported on the long edges, and given a concentrated loading at the center, as to the width of such a slab which may be considered as a beam carrying the concentrated load to the two supports? How does the percentage of reinforcement parallel with the supported edges and its position relative to the reinforcement from support to support affect the strength?"

229. Discussion by Sanford E. Thompson*

I know of no tests which indicate the distribution to the supporting beams of a concentrated load upon the slab. Unquestionably there is a distribution, so that the assumed breadth of the support can be taken considerably wider than the actual width occupied by the load. In case the longitudinal reinforcement in the slab is sufficient to warrant it, the distribution could be assumed on lines of 45 degrees. Without longitudinal reinforcement, the distribution would be to a certain extent a matter of judgment, and would depend upon the thickness of the slab to resist shear, as well as the location of the load and the dimensions of the slab.

232. Wearing Floors for Factories

"Do you know of any method in common use for protecting concrete floors against heavy trucking, in warehouses, for instance?"

232. Discussion by M. C. Tuttle**

"We have used several methods for this particularly in paper mills where the wet stock is handled in big boxes which are supported by small iron wheels. Here we have used cast-iron plates which were bedded in the concrete, and have also used a rack made of flat bars of steel with washers between them, in general, like a rack for a head gate in a canal. The edges of the flat bars take up the wear of the trucking and have proved quite satisfactory. This is probably the cheapest form of steel wearing surface which we have used."

†It is only fair to say that many instances are on record where walls of concrete block have withstood similar tests.—Editors.

‡Washington, D. C.

*Consulting Engineer, Newton Highlands, Mass.

**Boston.

233. Lining a Reinforced Concrete Oil Tank

"Can a thin-walled reinforced concrete oil tank, for use of lubricating oil be lined with the usual waterproof lining without resulting in the attack and destruction of the same by the ingredients in the oil?"

[The above question and the following discussion are translated from a recent issue of *Zement und Beton,* and are of interest as bearing directly on our American problems.—Consultation Editor.]

233. Discussion

An Austrian plant uses a reinforced concrete tank without any special lining except an ordinary cement finish in the proportions 1:1:5. Recent tests have shown that the fatty ingredients in the animal oils are dangerous to cement. The sebacic acid found in all animal oils, while not in itself strong, has a destructive influence on cement when allowed to attack it in large quantities and for a considerable time. The best cement finish for oil tanks is about 0.8 in. thick, and composed of the best Portland cement, and a clean, sharp, fine grained quartz sand, mixed in the proportion 1:2 and 1:3. Wherever the inner surface of the tank shows quartz sand particles, the sebacic acid will form a gelatine like layer of silicate, and will fill the pores of the cement finish, preventing any penetration of the acid. The concrete should have set thoroughly before the cement finish is placed, and the same holds true for the finish before filling the tank with oil.

234. Cost of Concrete Cornice

"I have been looking for some data on the cost of concrete cornices on large buildings. Any inforbe obtained from the former or the lateer per hour?"

234. Discussion by C. M. Leonard*

The design, type of finish desired, accessibility, etc., all affect the cost of concrete cornices. We have done a great deal of this work both plain and ornamental.

As to whether or not the work can be cast on the ground, and then set as cut stone would be, and whether or not it must be cast in place along with adjacent curtain walls, columns, and girders is another.

The whole question of cost of any kind of work is like the proverbial cotton string. We haven't any data on this concrete cornice subject that is available for publication. I think that contractors in general are inclined to under estimate the cost of this class of work. I don't mean by a small margin but I mean by several hundred per cent.

*Pres. Leonard Construction Co., not Inc., Chicago.

237. Shrinkage and Temperature Cracks

"What is the theory pertaining to the reinforcing of the concrete structures to prevent shrinkage and temperature cracks?"

237. Discussion by G. A. Hool*

In reinforced concrete structures which are free to contract and expand, the stresses occurring from temperature changes and from shrinkage in hardening are due wholly to the mutual action of the steel and concrete. Of the stresses produced from these two causes, those which result from hardening are the greater, but experiments show that even these are not sufficient to be of practical importance. In regard to the temperature stresses, they are negligible by reason of the nearly equal rates of expansion of the two materials.

If reinforced concrete structures, on the other hand, are restrained by outside forces, or if they are of such dimensions that they cannot be considered as sufficiently well bonded to act as a unit—such as long retaining walls—then the stresses resulting are much greater and the tensile strength of the concrete will be reached (this will occur with a drop in temperature somewhere between 10 and 20 degrees)—thus producing cracks, called contraction cracks. To prevent plainly noticeable cracks due to shrinkage or lowering of the temperature, steel should be inserted—the amount used varying in practice from 0.2 to 0.4 of 1 per cent based on the cross-section of the concrete. If the structure is fixed in two directions, the reinforcement must be placed accordingly.

No amount of reinforcement can entirely prevent contraction cracks. The steel can, however, if of small diameter and placed close to the surface, force the cracks to take place at such frequent intervals that the required deformation occurs without any one crack becoming large. No cracks will open up to be plainly noticeable until the steel is stressed beyond its elastic limit. The amount of steel should be such, then, that without being stressed beyond its elastic limit, it will withstand the tensile stress resulting from the maximum fall of temperature (usually considered to be 50°) in the steel itself plus the tensile stress necessary to crack the concrete. A high elastic-limit steel is thus advantageous.

The size and spacing of the cracks will also depend upon the bond strength of the reinforcing rods. The distance between cracks in any given case will be the length required to develop a bond strength equal to the tensile strength of the concrete. Thus bars with irregular surfaces which provide a mechanical bond with the concrete are in general more effective than smooth bars.

*Assistant Professor of Structural Engineering, University of Wisconsin.

238. Efficiency of Pulverizers

"Can you tell me whether a pulverizing cylinder 6 ft. in diameter 22 ft. long requires less power when in operation than a cylinder 5 ft. 6 in. diameter 24 ft. long; also whether a larger capacity can be obtained from the former or the latter per hour?

238. Discussion (Editorial)

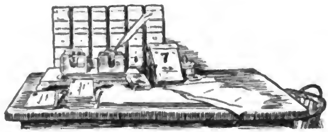
In practice very little difference, in our opinion, would be noted between the production of a tube mill 6 ft. in diameter and 22 ft. long and one 5 ft. 6 in. in diameter and 24 ft. long. Theoretically the 6-ft. mill might require a little more horsepower and possibly give a little greater production. We know of no directly comparative tests between mills of this character.

HOW A CONCRETE COAL POCKET ACTED AS A FIRE WALL

The Archibald Wheel Co., at Lawrence, Mass., recently had a very severe fire that entirely consumed about all their hub sheds and contents, the same being full at the time. The fire also damaged the roofs of two other sheds. The wind which was blowing a little south of east at the time carried the flames directly against the concrete coal pocket

CONCRETE COAL POCKET WHICH ACTED AS A FIRE WALL.

erected by the Aberthaw Construction Co., of Boston. This 1,000-ton coal pocket of the Gage Coal Co. has a wooden roof and behind it are situated a stable and storehouse of the company, where they store their cement and lime, and also in the rear of the pocket is a group of manufacturing buildings of the Archibald Wheel Co. The buildings behind the coal pocket were all of wood construction and both the Gage Coal Co. and the Archibald Wheel Co. state emphatically that nothing but the concrete coal pocket, acting as a fire wall, prevented the total loss of further property.



CORRESPONDENCE

Concrete in Kansas City

It seems to me that Kansas City is a very good place to hold a Cement Show because the people of Kansas City have shown their confidence in the various uses of cement and it is now used on nearly all classes of public work.

During the past year the Board of Public Works of Kansas City has awarded contracts for over $650,000 worth of sewers, 60 per cent of which are in sizes over 30 ins. in diameter and are constructed entirely of concrete. Recent specifications have been adopted admitting cement pipes for sewers in sizes below 30 ins. In addition to this, the Kansas City Terminal Company are building for the use of the city, "O. K. Creek" sewer at a cost of $750,000. The largest section of this will be double box form, each box over 15 ft. square, and will be constructed entirely of reinforced concrete. The Terminal Co. are also building a new Union Station, costing $3,500,000, in which there is a great deal of plain and reinforced concrete. Carrying out this line of improvement for the Terminal Company, the railroads are building viaducts and subways for the city streets, which will be almost exclusively of reinforced concrete and will cost in the neighborhood of four million dollars.

The city has contracts under way for about $100,000 worth of reinforced concrete bridges and are planning on building as many more the coming year. This does not include the 12th Street Traffic Way proposition which will contain a reinforced concrete viaduct, costing approximately $600.000. Work on this viaduct will probably be started this spring.

Kansas City is also distinctive in its use of concrete pavements, of which about $90,000 worth were laid during the past season. This pavement, on account of its cheapness, durability, and other good qualities is becoming quite popular and will be used more extensively during the coming season on outlying residence streets. During the past year over $300,000 worth of other kinds of pavement were laid, which had a concrete foundation, and about $120,000 worth of concrete sidewalk and curbing were laid under city contract.

The city has also let a contract for a Municipal wharf house to cost $30,000. This building will be of steel frame construction but will be finished on the outside with metal lath and cement plaster.

This brief summary of work, of course, does not include any of the work done by private individuals for buildings, paving, or walks. We expect that the coming year will show a large increase in all the above improvements.

CLARK R. MANDIGO.

Assistant City Engineer,
Kansas City, Mo.

The "Control Beam" for Testing Concrete

The principle involved in Dr. Von Emperger's form of control beam is excellent. The long length of beam obviates failure by shear and the large percentage of reinforcement provides for a compression failure. It would be expected that this form of test would give more uniform results than the cube test but it probably would not be better in this respect than the test of cylinders of concrete. Whether the dimensions are the best and whether so narrow a beam would give consistent results in making under the conditions to be found around building construction are matters which only use or practice would determine. I am inclined to think that the beam is too narrow and too long. I hope that some form of test piece may be adopted and put into general use in concrete building construction.

A. N. TALBOT.

The University of Illinois,
Urbana, Ill.

The Tricalcium Aluminate Hypothesis

I note with some surprise on page 252 of your issue for December, that in an article entitled "The Production and Testing of Portland Cement," the writer in the last paragraph shows himself quite ignorant of the recent work of the Geophysical Laboratory. He seems unacquainted with the fact that Shepherd has found that tricalcium silicate exists in the three component system, and I can see no reason why anybody should assert, as your writer does in the last two lines that "it is not believed from experiments made by myself that the tricalcium aluminate hypothesis is correct." Since Shepherd was compelled to revise the conclusions derived from his investigation of the two component series, after his examination of the three component series, it is quite within the bounds of possibility that his conclusions for that series will have to be revised when, the four component series, or true Portland cement, is studied.

CLIFFORD RICHARDSON.

Consulting Engineer, New York.

Lumber dressed on all four sides is best for concrete work. The first cost is so little more that it will be over-balanced by the convenience in handling and working up and placing.

The Original Cincinnati Grandstand

With reference to your paper in your issue of January,* relating to the demolishing of the reinforced concrete grand stand at Cincinnati, you state that the same was built by the Ransome Concrete Company in accordance with what was then known as the Ransome System. We beg to inform you that the Ransome Concrete Company was in no wise connected with the erection of this grand stand.

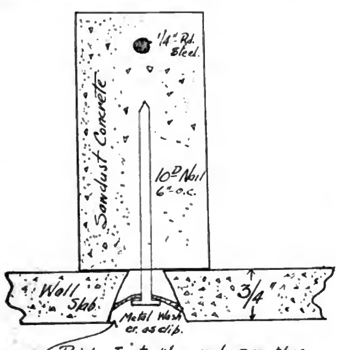
Ernest L. Ransome.

New York City.

Suggested Unit Wall Construction

The use of light weight slabs for wall construction offers many interesting possibilities, and the accompanying sketch shows a detail which, I believe, could be worked out very satisfactorily. I have followed the work of Mr. Wagner, at Toronto with much interest, also that of Mr. Beardsley of Cleveland, and the only points in this suggestion with any claim to originality, are, the use of sawdust concrete in the studding, which would allow nailing, and, the features of the nail and mortar joint.

The construction is very analogous to ordinary frame construction, using 2 x 4-s, and sheathing. This uses a concrete 2 x 4 (or any required size) and concrete sheathing, nailed on.



SKETCH SHOWING SUGGESTED UNIT WALL CONSTRUCTION.

All the work is pre-cast and methods of erection would follow frame construction. Set the studding with the proper sills, stretchers, etc., and sheath them with the wall slabs. A washer is placed over the heads of the nails to hold the slabs in place. If required, a light wire could be run along the nail heads to reinforce the mortar joint longitudinally. The stud could be reinforced to withstand handling and nailing if required.

The inside of the wall could be furnished just as a frame house, using expanded metal or plaster board, and plaster.

W. R. T.

Cleveland, Ohio.

*Page 22.

OUR WESTERN OFFICE AND MANAGER

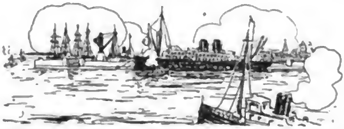
Arthur E. Warner who has been for the past year the western manager for CEMENT AGE and who was previously connected with *Concrete Engineering* from the time of its establishment has resigned to join the staff of the *Engineering Record.* His place as western manager will be filled by Robert M. Babbitt who was for three years western representative of the *Electric Railway Journal.* The publishers of CEMENT AGE accepted Mr. Warner's resignation with great regret, realizing that his loyal and efficient service have been largely instrumental in increasing the prestige of the magazine. They bespeak for Mr. Babbitt as he starts in on his new work the same measure of co-operation and support that was extended to Mr. Warner.

It has been deemed advisable in connection with the change announced above to move the western office of CEMENT AGE from Cleveland to Chicago. The new address is 1120 First National Bank Building.

Where a Man is His Own Builder

The Waterville (Me.) *Sentinel* says that in completing the only cement house in Skowhegan, Joseph Roderick has proved that a comfortable dwelling of modern style can be built for about $1,000. He has erected a house of concrete block 28 x 24 ft. with an *L* 12 x 17 ft., and a shed 15 x 15 ft. entirely of concrete and he will later build a stable of this material. The work and cost of building this is interesting to all home-builders. To put up this entire set of buildings he has used 3,000 blocks. There are 37 courses of them including the cellar. There were nine courses in the cellar. It is estimated that the entire cost of the material has been about $700. He has done the work himself, with the exception of a tender. It took him 60 days. He has made new molds for the work on the cornice, the frieze and coping.

The chimney in the house is entirely original, he having made the molds to make the concrete blocks. The blocks are 4 in. high and 3 in. thick and 9 in. long, and the chimney is double. Mr. Roderick reckons that he not only will save in the original cost of this building but because it is concrete he will not need insurance on it and therefore will save considerable expense. The $700 estimate has been reckoned for one who buys blocks at the rate of 25 cts. a block, but having made them, he estimates the cost of the building to him when finished inside at not more than $700.



FOREIGN NOTES

Translations made especially for CEMENT AGE by F. W. Scholtz

Use of Compressed Air for Raming Cement

The figure shows two of the compressed air rammers used to ram cement tiles of various dimensions. Tests showed that a tile of 3 ft. height and 3 ft. diameter could be rammed in 15 min. A compressor ranging from 4.5 to 15 h. p. in size is usually large enough for cement work. The speed of the rammer lies between 300-800 blows per minute. The large and rapid number of blows removes all voids from the cement tile, and gives them after four weeks a strength which is equal to that obtained with other methods after three months. The saving in cement it is claimed, amounts to about 25 per cent, when using compressed air rammers.—*Baumaterialien Markt.*

COMPRESSED AIR TAMPER.

Concrete Bridge and Cantilever Supported Glass Awning

A large German manufacturing plant was recently rebuilt in reinforced concrete. There were two adjoining buildings that had to be connected by a bridge over the street. The overall length of the bridge was 23.5 m. (77.5 ft.) with two spans of 18.2 m. (60 ft.) and 5.3 m. (17.5 ft.). To relieve the building of the load of the bridge, it was

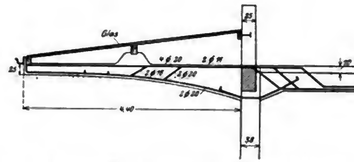
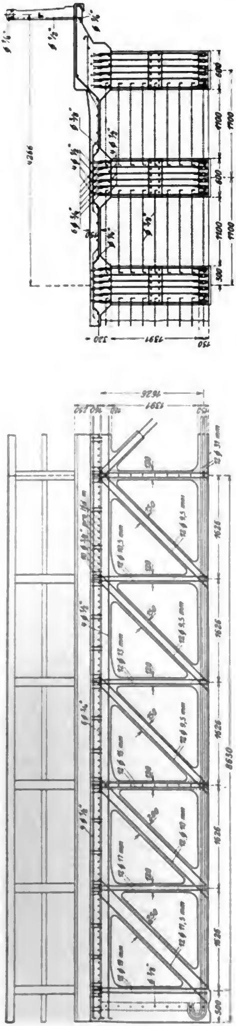


FIG. 2—SECTION OF CONCRETE CANTILEVERS.

necessary to use cantilever construction for the shorter span. The floor of the bridge is computed for an effective load of 400 kg. sq. m. (80 lb. sq. ft.). The bridge is covered by a fireproof concrete roof, which in turn is covered by a shingle surface. One of the longitudinal girders of the bridge sustains in addition to the load of the bridge superstructure itself, the additional load of a glass roof, which extends across the street between the two buildings, and means an additional load of 4,000 kg. (8,800 lb.). The bridge has numerous windows on both sides, so as to admit light and air. Fig. 1 shows a portion of the bridge and a second glass shelter extending from the front of the new building. This is interesting for the reason that reinforced concrete cantilevers were used to support the glass roof instead of the usual iron or steel girders. Fig. 2 shows in detail the cantilevered construction of the glass awning.—*Armierter Beton.*

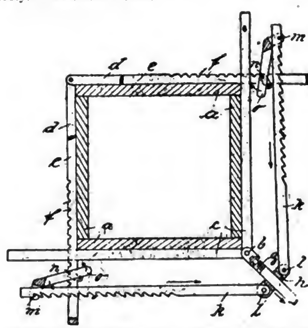
FIG. 1—GERMAN FACTORY BUILDINGS WITH GLASS AWNINGS SUPPORTED ON CONCRETE CANTILEVERS.



ELEVATION AND SECTION OF SKELETON BRIDGE ACROSS THE RUSSIAN RIVER, DESNA.

Unit Girder Bridge Over the Desna (Russia)

An unusual combination of wooden and reinforced concrete bridge is found in the case of the Desna bridge in Russia. The entire bridge is 557 m. (1,838 ft.) long, of which the two end sections, of 103 and 244 m. (331 and 805 ft.) are of "Visintini" beams, while the central length of 200 m. (660 ft.) length is constructed of wood. The length of the span for the reinforced concrete sections of the bridge is 17.2 and 19 m. (57 and 63 ft.) respectively. Each bent rests on three round columns, connected at the top by a cross girder, and encased in a reinforced concrete shell. The columns rest on a reinforced concrete slab, each one of which is carried by 16 "Strauss" piles, of 17-26 ft. in length. The bridge driveway over the end sections is carried at each span by five "Visintini" beams 6 ft. on centers. Each beam is 60 cm. (24 in.) wide, and 1.7 m. (5.6 ft.) high, and consists of a 32 cm. (13 in.) square upper member, a 15 cm. (6.1 in.) square lower member, 12 cm. (5 in.) square uprights, and 15 cm. (6.1 in.) square diagonals. Round steel rods were used for reinforcement, the arrangement being apparent from the figure. The roadway reinforced concrete slab between the beams as shown in the section is 15 cm. (6 in.) thick. The bridge is 8.54 m. (28 ft.) wide. The beams are inter-connected at various distances by means of reinforced concrete diagonal strut, so as to obtain the greatest possible safety.—*Armierter Beton.*

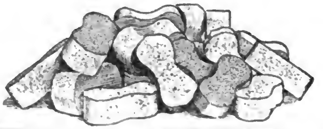


CLAMPING DEVICE FOR VERTICAL MOLDS.

Column Clamp

When concrete columns or posts are rammed in upright, vertical, instead of horizontal molds it is necessary to use special clamping devices, one of which is here illustrated.

The same consists of several pairs of bars, provided with notches, of which two cross each other and enclose the mold. A third pair *k* engages by means of a threaded spindle *g* a fork in the first pair, and presses a lever which fits into a notch of the second pair, against the first pair, thus clamping the entire device. Instead of the clamps usually used in molds, this new device can be attached, enclosing the entire mold on all sides, and drawn as tightly as needed from point *g* by means of a screw. —*Baumaterialien Markt.*



BRIQUETTES

MONTHLY COMPARATIVE TABLE

Imports of Portland, Roman and Hydraulic Cements.

Country	Month of Nov., 1910 Barrels	Value	Month of Nov., 1911 Barrels	Value
United Kingdom			10,590	$12,822
Belgium	17,112	20,580		
Germany	16,251	24,953	601	643
Canada	77	137	51	106
Other Countries	1,489	2,048	1,116	1,529
	34,929	$47,718	12,358	$15,100
Less Foreign Cement Exported	701	633	243	329
	34,228	$47,085	12,115	$14,771

Decrease in imports during the month of Nov., 1911, as compared with Nov., 1910 . . . . . 22,113 barrels

Country	11 Months Ending October, 1910 Barrels	Value	11 Months Ending October, 1911 Barrels	Value
United Kingdom	26,365	$ 29,894	12,397	$15,409
Belgium	116,001	151,525	8,571	10,396
Germany	99,714	144,477	113,358	182,610
Canada	6,193	9,006	1,052	2,046
Other Countries	22,345	31,657	11,341	17,014
	270,618	$366,559	146,719	$227,475
Less Foreign Cement Exported	16,970	23,653	8,377	13,854
	253,648	$342,906	138,342	$213,621

Decrease in imports during 11 mos. ending Nov., 1911, over 11 mos. ending Nov., 1910 . . . 115,306 barrels

Imports of Portland Cement into the U. S. during November, 1911 by Districts

District	Barrels	Value
Baltimore	82	$ 143
Bangor	2	4
New York	1,612	1,995
Philadelphia	22	34
Hawaii	10,590	12,822
Cape Vincent	2	3
Vermont	48	99
	12,358	$15,100

Exports of Cement

Exports of cement, month of Nov., 1910—151,437 bbls., value $221,299

Exports of cement, month of Nov., 1911—253,512 bbls., value $377,578

Increase in exports, month of Nov., 1911, over month of November, 1910 . . . . 102,075 barrels

Exports of cement, 11 mos. ending Nov., 1910, 2,226,768 bbls., value $3,137,223

Exports of cement, 11 mos. ending Nov., 1911, 2,905,516 bbls., value $4,301,958

Increase in exports during 11 mos. ending Nov., 1911, over 11 mos. ending November, 1910 . 678,793 barrels

Danish Pebbles for Cement Grinding

Flint pebbles are found along the coasts of certain Danish islands, where they have been thrown up by the force of the waves and buried in the so-called "mines," which are old deposits of stones and sand along the shore. These collections have been forming for centuries, and the pebbles are now found amongst enormous quantities of sand and other stones. Men are employed to dig these pebbles from the mines, where they lie from 12 to 16 ft. deep. From this debris, all the pebbles of commercial value, having a greatest diameter of from 1 to 5½ in., and of shape conforming to the standard given, are carefully selected. From this it will be seen that an exporter's stock of flint pebbles is composed of all sizes marketable. The stones are sold just as they are taken from the mines, exactly as the constant action of the waves has shaped them.

The pebble mines, as described in a recent report from Wallace C. Bond, United States Consul at Copenhagen, are worked by gangs of 3 to 16 men; and the pebbles dug are collected at various depths along the coast, whence they are shipped by boat to the wholesalers' yards at Copenhagen, where they are carefully assorted according to quality and size.

Sizes 2, 3 and 4 in. are in most demand; and if a firm in the United States should place an order for 2,000 tons annually of one of these sizes—say, the most popular one—there would be an increase in its price, for the reason that in order to get 2,000 tons of this one size, 8,000 tons of other sizes would have to be mined. On the other hand, if orders were for 2,000 tons of mixed sizes—say, of 2, 3 and 4, or of 3, 4 and 5 in.—there would be no increase in the present prices. The supply in the mines is ample to meet an increased demand of 2,000 tons or more. The only difficulty would be in finding a market for the extra pebbles in case 2,000 tons of one size were delivered annually to one importer.

Hurry and Seaman Patent Decision

The U. S. Court of Appeals, sitting in Chicago, recently affirmed the decision of the U. S. Circuit Court made at Indianapolis about a year ago which refused to sustain the patent issued to Hurry and Seaman covering a process of burning pulverized coal in rotary kilns. While Hurry and Seaman were, without doubt, the first engineers to burn cement with pulverized coal successfully in rotary kilns, yet other engineers, in going from oil to coal for fuel, could, to quote Judge Baker, make use of the "known prior art coal injectors." The Hurry and Seaman patent, according to the decision of the Court, does not cover all forms of burning pulverized coal in rotary kilns, and other engineers using coal injectors and experimenting with other factors in coal feed and air pressure, have developed successful burners.

Investigations on the influence of locomotive gases on fresh mortar in tunnels showed that mortar protected from the gases while setting is not attacked, provided it is thoroughly dry when the gases strike it. Moisture in mortar aids in its destruction, due to the production of sulphuric acid and sulphur dioxide.

PRELIMINARY ESTIMATE OF PORTLAND CEMENT PRODUCTION IN 1911

Complete statistics for the year 1911 were received by the United States Geological Survey during the month of January from about 70 per cent of the Portland cement manufacturers in the United States. Based on these returns an estimate has been made by Ernest F. Burchard of the U. S. Geological Survey of the entire output for the year. It is believed that this estimate is within 2 per cent of the exact quantity of Portland cement manufactured in 1911. There was apparently a slight increase in the production of 1911 over that of 1910, amounting to about 1,300,000 barrels, approximately 77,877,236 barrels having been made in 1911 as compared with 76,549,951 barrels in 1910. This represents an increase of only 1.7 per cent as compared with the increase of 17.7 per cent that occurred in 1910 over the previous year. The figures for 1910 and 1911 are so close that when complete returns are received possibly a slight decrease in production may be shown. The average factory price per barrel not including packages was 86.7 cts. in 1911 as compared with 89.1 cts. in 1910, a decrease of 2.4 cts. per barrel or 2.68 per cent. In place of the five geographic districts formerly considered by the Survey, the United States has been divided into 11 sub-divisions based on the grouping of plants in direct relation to the trade territory covered by each group. This grouping is also more logical when the raw materials are considered. For instance the plants in northeastern Indiana using marl are grouped with the Michigan plants, many of which use marl, and the plants in southern Indiana and northern Kentucky, all of which are near Ohio river, and all of which use hard limestone, are grouped together. Plants near Chicago, whether in Illinois or Indiana, are logically grouped together because of their nearly equal freight rates. The southeastern States, in which plants use mostly Appalachian limestone, are grouped together, and Texas has been transferred to the group of Great Plains States, with which it more logically belongs. Plants between Missouri river and Mississippi river in Missouri and Iowa are grouped together, and the plants in the Rocky mountain States are considered in a separate group.

An attempt has been made to estimate the shipments of cement by districts for 1910 and 1911, but with regard to such statistics there are fewer data and the figures are not regarded as quite so accurate as those of production. 1911 was the first year in which inquiries have been made by the Survey with regard to stocks on hand. According to returns received there were decreases in production in the following districts: Lehigh, Kentucky, and southern Indiana and in the Great Plains and Mountain States. The increases recorded were in New York, Ohio and western Pennsylvania, Michigan and northeastern Indiana, Illinois and northwestern Indiana, the southeastern States, Iowa and Missorui, and in the Pacific Coast States. Slightly better prices were realized in the Lehigh District, New York, and on the Pacific Coast, but in Michigan and northeastern Indiana, Illinois and northwestern Indiana, and in the Great Plains and Mountain States the average price was lower than in 1910, but in western Pennsylvania and Ohio, southern Indiana and Kentucky, the southeastern States, and in Iowa and Missouri the price remained about the same.

For the sake or ready reference these statistics are arranged in tabular form.

As a matter of information to the readers of CEMENT AGE, it must be remembered that the prices in the Lehigh and New York districts, which seemingly show an advance in price in 1911 over 1910, are a little misleading. In 1910 the manufacturers in the two districts named packed their cement in bags which were charged at 10 cts. outbound and were credited at 7½ cts. each inbound. This resulted in a profit on the bags, averaging from 7 to 8 cts. per bbl.

In 1911 bags have been billed out at 10 cts. and credited at 10 cts., thus showing no profit. A re-construction of the figures based upon the conditions existing in the two years, would show that instead of there being an advance in price in the Lehigh and New York districts, there was a decrease in price of about 4½ cts. owing to the different method used in handling the packages.

STATISTICS OF PORTLAND CEMENT INDUSTRY, 1910 AND 1911.

States	Active plants 1910	1911		Production and shipments 1910	1911	Change per cent	Aver. factory price per bbl. 1910	1911
Eastern Pennsylvania and New Jersey (Lehigh district)....	24	23	Prod.	26,315,359	25,924,516—	1.5	$ .729	$ .763
	..	..	Ship.	27,033,313	25,634,671—	5.2	....	....
New York	8	7	Prod.	3,296,350	3,314,217+	.5	.808	.841
	..	..	Ship.	3,059,539	3,058,463—	.04	....	....
Ohio and Western Pennsylvania	9	9	Prod.	6,072,987	6,675,249+	9.9	.775	.770
	..	..	Ship.	5,615,662	6,553,895+	16.7	....	....
Michigan & Northeastern Indiana	14	12	Prod.	4,524,591	4,570,033+	1.0	.870	.849
	..	..	Ship.	4,508,738	4,436,462—	1.6	....	....
Kentucky and Southern Indiana	3	3	Prod.	2,824,832	2,818,820—	.2	.799	.802
	..	..	Ship.	3,016,413	2,738,630—	9.2	....	....
Illinois & Northwestern Indiana	6	6	Prod.	8,376,450	8,617,341+	2.9	.940	.836
	..	..	Ship.	8,151,294	8,537,442+	4.7	....	....
Southern States (Maryland, Virginia, West Virginia, Tennessee, Georgia and Alabama)	8	10	Prod.	3,071,009	4,005,001+	30.4	.793	.81
	..	..	Ship.	2,800,563	3,723,183+	32.9	....	....
Iowa and Missouri.............	6	7	Prod.	5,722,971	6,060,261+	5.9	.916	.911
	..	..	Ship.	5,261,160	6,008,503+	14.2	....	....
Great Plains States (Kansas, Oklahoma and Central Texas)	16	16	Prod.	7,723,253	6,904,468—	10.6	.996	.871
	..	..	Ship.	7,087,296	6,743,060—	4.8	....	...
Mountain States (Colorado, Utah, Montana, Arizona and Western Texas)	8	7	Prod.	2,236,561	2,117,930—	5.3	1.288	1.15
	..	..	Ship.	2,065,393	1,974,476—	4.4	....	...
Pacific Coast (California and Washington)	9	11	Prod.	6,385,588	6,869,400+	7.6	1.354	1.40
	..	..	Ship.	5,941,340	6,523,106+	9.8	....	...
Totals	111	111	Prod.	76,549,951	77,877,236+	1.7	$ .891	$ .867
	..	..	Ship.	74,540,711	75,931,891+	1.9		

THE SECOND NEW YORK CEMENT SHOW

WHEN the band played "Home Sweet Home" at Madison Square Garden, New York shortly after 10 o'clock on Saturday evening, February 3rd, the second New York Cement Show, which opened on Monday evening January 29th, had passed into history and another eminently successful exhibition had been added to the record of the Cement Products Exhibition Company.

Although in a sense all cement shows are alike, it is equally true that each succeeding one has sufficient individuality so that it cannot justly be compared with any other. Those who remember the crude exhibits of five or six years ago can hardly believe that from such beginnings have developed the great industrial fairs now held under the name of Cement Shows.

The setting for the New York show was by far the best yet designed. Green and white was the color scheme of the roof decorations while at either end of the great arena were huge panoramas depicting villas, pergolas, statuary and other applications of concrete set in a rural scene of much artistic merit. The railings and partitions dividing the exhibits were of staff surfaced to represent concrete and were of pleasing architectural design. All signs, furniture and floor coverings were of uniform style furnished by the management, as usual. Music of excellent quality was furnished afternoons and evenings by D'Arquin's Military Band.

While the number of exhibits was considerably smaller than last year, this was the one respect in which the show failed to equal the record-breaking affair of December, 1910, and it is highly probable that to most of those in attendance the great variety of the exhibits and the unusual care spent in their preparation more than offset the decrease in number. The fact that all the available space was not sold gave room for a highly interesting exhibition of photographs and architectural drawings covering every type of concrete residential and business structure, and this feature was much appreciated by the public.

In point of attendance the show was perhaps the most satisfactory to the management and the exhibitors of any yet held. The attendance on Saturday, the closing day, was the largest in the history of cement exhibitions. The daily average throughout the week was 27,700, and of this total a very large percentage paid at the box office. Free admission tickets good for the opening night only were printed in the newspapers on Monday, January 29, and this experiment was apparently successful from an advertising standpoint, judging from the results later in the week.

It was a matter of frequent comment by the exhibitors that the quality of the attendance was unusually good. While the show lacked the element of novelty that was present last year and had no big drawing card such as Sousa's Band proved to be, it nevertheless attracted those whose interest in concrete is real and lasting. architects, engineers, contractors, railroad men, heads of manufacturing establishments and actual workers in concrete were present in large numbers and showed keen and intelligent interest in all they saw. The man who still thinks Portland cement is made in Portland, Maine, was conspicuous by his absence. Records kept by many exhibitors showed that people had come from considerable distances expressly for the show. New England, New Jersey, New York State and Pennsylvania were well represented while at least on man came all the way from San Francisco.

As has already been said, the exhibits were exceedingly varied in character and covered the whole range of the ornamental and practical uses of cement, as well as the machinery, apparatus and tools used in concrete work. There were 31 exhibitors who had not previously been represented in any cement show and their satisfaction with the experiment may be judged from the fact that the majority of them contracted for space in the Chicago and Kansas City shows during the week. It may be mentioned in passing that the management report the space at Kansas City as practically all sold and it is expected that the entrance of the exhibition company into this new field will be unusually successful.

It would be manifestly impossible in the short time available and with the limited space at our disposal to attempt a detailed description of the exhibits. Probably no exhibit attracted more attention than a large model in relief of that section of the Panama Canal Zone comprising the Gatun locks and dam. This was a part of the Atlas Cement Company's exhibit. In the Pennsylvania Cement Company's exhibit was a reproduction of the tomb of Geronimo, the Arab boy who was buried alive in concrete centuries ago by the Moors. The story of Geronimo was told in CEMENT AGE several years ago and was extensively quoted in the newspapers at the time. New methods of concrete house construction such as the Morrill and Blaw forms and the Deutsch sectional house received especial attention from the prospective home-builders and the architects. An exhibition of asbestos shingles, asbestos wood and asbestos stucco by the Johns-Manville Company, was a new feature among cement show exhibits.

In the machinery line several ingenious novelties were shown, perhaps the newest being the automatic stucco machine by which a finish of splatter-dash is applied by a revolving cylinder equipped with steel springs. The "Cement gun," first exhibited at the shows last year, was apparently more popular than ever. Besides those exhibits mentioned above there was a very representative

showing of mixers, block, brick and tile machines reinforcing systems, waterproof paints, coatings and compounds and material-handling machinery and equipment. The man who didn't find what he was looking for was hard to please.

Credit should be given to President Hagar, General Manager Beck and their associate officers for their skillful handling of the show. It would also be unfair to omit mention of the highly successful work of M. E. Gordon, of Chicago, the Installation Manager. Under his experienced handling there was practically none of the friction between the exhibitors and management that has sometimes been evident in the past. The management arranged with exhibitors to transport exhibits from the Garden to Chicago and for delivery at the Coliseum for the Chicago Show in all cases where this was desired.

Another "invasion of the East" has been successfully accomplished by the energetic westerners of the Cement Products Exhibition Company and the gospel of concrete has been brought to the notice of additional thousands in a way that cannot fail to advance the cause of the greatest of building materials.

Coming Cement Exhibit in Boston

The second Cement and Concrete Show, to be held in connection with the Third Exhibition of Textile Machinery and Mill Supplies under the auspices of the Textile Exhibitors' Association, Boston, will take place in that city April 22 to 27, inclusive. The exhibition will be held in the Mechanics Building. Manufacturers will be especially interested in concrete as used in factory construction, owing to its fire-resisting and non-vibrating qualities.

In the 1910 Boston Textile Exhibition, in response to the request of many firms in New England interested in the subject of Concrete Construction, a portion of space was devoted to a Cement and Concrete Exhibit. This, owing to the short notice given, was not as complete as desired, but served the purpose of bringing forcefully to the attention of the mill owners and others interested in building operations in this section of the country the great superiority in this type of construction, and created an interest that has been steadily growing.

With the announcement of the Third Textile Exhibition to be held next April, in connection with the National Convention of Cotton Manufacturers it is intended to present a much more comprehensive exhibit of the Concrete Industry than ever before held in New England.

The Bureau of Associated Geological Engineers, of 131 State st., Boston, an association that has met with much success in other lines of geologic engineering, has recently entered the cement field, specializing in examinations of cement properties, building stones, and other structural materials, and in chemical analyses and physical tests of all structural materials. Its staff also includes specialists in examinations for bridge and dam foundations and allied lines of geologic engineering.

KANSAS CITY CONVENTION OF THE NATIONAL ASSOCIATION OF CEMENT USERS

The decision to hold the eighth annual convention of the National Association of Cement Users at Kansas City, Mo., March 11-16, 1912, will, perhaps, inconvenience some Eastern members, but it is unquestionably a wise decision.

This Association is national in character, and it would seem the part of wisdom that a convention should be held west of the Mississippi river. The stimulating effect of this convention in the West will doubtless be felt in the increased use of cement and in the information imparted as to the proper way to use it. It will undoubtedly result in the acquirement of new members, which will still further strengthen the Association. The tentative program indicates the high order of the papers and discussions to be presented, and the papers from Russia, Austria, Germany and other foreign countries indicate the wide-spreading influence of this Association, which is attaining an international character. It is understood that joint sessions will be held with the State Highway Engineers' Association in the vicinity of Kansas City, and similar organizations, at which sessions specifications for concrete roadways will be considered and acted upon. Papers will be presented on concrete roadways, concrete sewers, drainage tile and other matters relating to highways which is a matter of vital importance to the west, especially to the farmer. The report of the Committee on Concrete nresenting data relating to the tests of actual buildings during the year, contributing data on the question of floors and the presentation of papers and discussions on the flat slab and other structural parts of buildings, will be data of great importance which cannot be secured through any other source. The *Proceedings* of last year's convention contained much information of the greatest practical value, and it is admitted by many engineers and architects that this volume contains data of great practical value. It cannot be obtained elsewhere and has been the means of securing the membership of many prominent men.

A paper of interest is that by one of the members in Moscow, Russia, which describes the introduction of the concrete "clock house" in Moscow and its great advantages. A number of papers by prominent authorities in Europe emphasize the high appreciation in which the work of the Association is held in foreign countries. The wisdom of the association in devoting a considerable part of its crowded program to the discussion of concrete highways and the methods of construction and drainage, will be doubtless appreciated by those engaged in the cement industry in the west, and the stimulating effect that this will have in promoting concrete highways will undoubtedly greatly increase the consumption of Portland cement. The full week required by the program will be of unusual interest to all interested in the use of cement and it certainly will repay all those who can possibly do so to attend this convention.

TENTATIVE PROGRAM.

The tentative program is as follows:

Concrete Highway Bridges. Walter Scott Gearhart, Highway Engineer, Extension Department, Agricultural College, Manhattan, Kansas.

The Dallas Oak Cliffe Viaduct. Ira G. Hedrick, Consulting Engineer, Kansas City, Mo.

Flat Slab Bridges. W. H. Finley, Assistant

Engineer, Chicago and Northwestern Railroad, Chicago, Ill.

An Improved Concrete Pavement. E. W. Groves, City Engineer, Ann Arbor, Mich.

Cement Paving as Constructed at Mason City, Iowa. F. P. Wilson, City Engineer, Mason City, Ia.

Report of Committee on Roadways, Sidewalks and Floors. C. W. Boynton, chairman.

The Use of Cement in Irrigation Work. F. H. Newell, Chief Director, U. S. Reclamation Service, Washington, D. C.

Reinforced Concrete in Agriculture. W. A. Collings, Engineer, Builders Material Supply Company, Kansas City, Mo.

Methods of Testing Sewer Pipe. Duff A. Abrams, Assistant Professor, Engineering Experiment Station, University of Illinois, Urbana, Ill.

Advantages and Durability of Cement Sewer Pipe. Gustave Kaufman, Engineer, The Wilson and Baillie Manufacturing Company, Brooklyn, N. Y.

Reinforced Concrete Water Purification Works. Dr. Walter M. Cross, City Chemist, Kansas City, Mo.

The Control Beam as a Field Test for Concrete. Fritz E. von Emperger, Consulting Engineer, Vienna, Austria.

Continuous Concrete Beams. Dr. E. Probst, Consulting Engineer, Professor, Royal Technical High School, Berlin.

Notes on the Deformation in the Webs of Rectangular Concrete Beams. H. C. Berry, Assistant Professor of Materials of Construction, University of Pennsylvania, Philadelphia, Pa.

The Design and Construction of a Reinforced Concrete Dome, 220-ft. Span. Dr. S. T. Trauer, Chief Engineer, Breslau, Germany.

The Design of Reinforced Concrete Domes. H. Brussel, president, Reinforced Concrete Company, St. Louis, Mo.

Report of Committee on Reinforced Concrete and Building Laws. A. E. Lindau, chairman.

The Construction of Concrete Grain Elevators. John S. Metcalf, Consulting Engineer, Chicago, Ill.

The Design of Concrete Grain Elevators. E. Lee Heidenreich, Chief Engineer, Builders Material Supply Company, Kansas City, Mo.

Report of Committee on Measuring Concrete. Robert A. Cummings, chairman.

Report of Committee on Nomenclature. Peter Gillespie, chairman.

Report of Committee on Specifications and Methods for Concrete Materials. Sanford E. Thompson, chairman.

Report of Committee on Treatment of Concrete Surfaces. L. C. Wason, chairman.

Report of Committee on Insurance. W. H. Ham, chairman.

The Handling of Concrete in the Construction of the Panama Canal. S. B. Williamson, Engineer, Pacific Division, Panama.

Concrete Piles and Harbor Work. Dmitri Alexeev, Engineer, Russian Northern Railway, Moscow, Russia.

Methods of Construction Used in the Arbuckle Building, Brooklyn. R. C. Wilson, Assistant Engineer, Turner Construction Company, New York, N. Y.

Construction of the Hollow Reinforced Concrete Dam of the Portland Railway Light and Power Company. Robert S. Edwards, Consulting Engineer, Portland, Ore.

Discussion of Advantages and Comparative Cost of the Hollow Concrete Dam. W. L. Church, president, Ambursen Hydraulic Construction Company, Boston, Mass.

The Construction of the Fireproof Type of School House with Separately Molded Members. Theodore H. Skinner, architect, Oneida Community, Ltd., Oneida, N. Y.

Discussion of the Use of Calcium Chloride as a Preventative from the Freezing of Concrete. Richard K. Meade, Chief Engineer, Tidewater Portland Cement Company, Baltimore, Md.

Some Notes on the Value and Comparative Cost of Reinforced Concrete Telegraph Poles. George Gibbs, Chief Engineer of Construction, Pennsylvania Railroad, New York, N. Y.

Concrete Fence Posts. W. J. Towne, Assistant Engineer, Chicago and Northwestern Railroad, Chicago, Ill.

Reinforced Concrete Telegraph Poles. Robert A. Cummings, Consulting Engineer, Pittsburgh, Pa.

Report of Committee on Building Blocks and Cement Products. P. S. Hudson, chairman.

The Concrete Block Industry in Russia. Alexander Zuberbuhler, Engineer, Moscow, Russia.

The success of the banquet in New York last year was such as to indicate the great desir-bility of having a similar one at Kansas City. This has been arranged for Friday evening, and the speakers will be men of national reputation, and the occasion will undoubtedly be as enjoyable as the first.

Many of the State Highway Associations, and those interested in Good Roads, are arranging to hold joint sessions, at which "Concrete Roads," "Highway Bridges," and "Drainage" will be subjects for consideration.

It is no exaggeration to say that the number and character of the papers and reports will exceed the high-water mark of last year. From present indications the attendance will also far exceed that at the New York Convention.

Papers of vital interest to designing engineers will come up for consideration, and a number of important specifications will be adopted. No one should fail to attend this Convention.

Meeting of the Mission Highway Engineers' Association

The officers of the Missouri Highway Engineers' Association have just decided to hold the next annual convention of the Association in Kansas City during the first Annual Kansas City Cement Show, March 14-21. The meeting of this organization during the cement exhibition, will be welcomed by the exhibitors and the cement show interests generally.

Annual Meeting of the American Society of Engineering Contractors

The Third Annual Meeting of the American Society of Engineering Contractors, was held in New York City on the 9th day of January, 1912. In the forenoon, members of the Society visited, in a body, the new Grand Central Terminal, at the invitation of W. L. Morse, Terminal Engineer of the N. Y. Central & Hudson River R. R. Co. Great interest was shown in the remarkable work, which will result in probably the greatest railroad terminal in the world.

At the afternoon session, which was devoted to a business meeting, the address of the retiring president of the Society, W. R. Harris, was read. Mr. Harris who, for nearly one year, has been located in the Canadian Northwest at Regina and Saskatoon, Sask., was unable to be present. He stated that even in those distant provinces much interest is evinced regarding the work undertaken by this Society, which is about to be manifested by the organization of branches.

After Mr Harris' address was read, the result of the election of officers was declared. The following officers were elected: Pres., Maj. C. E. Gillette, of Philadelphia, Pa.; 1st vice-pres., H. J. Cole, of New York, N. Y.; 2d vice-pres.,

John Marshall, of Regina, Sask., Can. Directors: W. B. Bamford, of Belmar, N. J.; Carl Weber, of Los Angeles, Cal.; C. A. Mees, of Charlotte, N. C.

A point discussed with much interest was the question of practical specifications. Only too often specifications are written that would require a miracle to carry out, in fact, they are an absolute impossibility; yet contractors are constantly asked to bid on such specifications and they must do it, if they want work. The result is that no end of trouble is experienced. Ultimately the cost must be shouldered by the public, who are powerless to prevent it. Therefore, it behooves an organization like this Society to avail itself of the unexcelled opportunity that is now available to accomplish something of lasting benefit not only to contractors, but also to the public.

The remainder of the evening was devoted to a talk by J. R. Wemlinger, on "Methods and Cost of Driving and Pulling Steel Sheet-Piling." This was illustrated by means of one hundred and twenty-five lantern slides showing all known methods of installing sheet-piling of all kinds in the United States and foreign countries.

The headquarters of the American Society of Engineering Contractors are at 13-21 Park Row, New York City.

Coming Architectural and Engineering Exhibition

Architecture of the world is promised in drawings and models at the second annual Architecture and Engineering Exhibition to be held at the 71st Regiment Armory, Park Avenue and 34th Street, New York, from March 25 to 30.

Models have already been completed of buildings in Japan, China, Africa and India and leading architects have been invited to contribute models of prominent buildings contemplated or in course of construction in this country. Architectural and engineering schools and colleges will also exhibit models or drawings made by their students.

Comprehensive exhibits of building supplies, materials and accessories will also be made and in conjunction with the exhibition a conference of architectural, building, contracting and engineering interests will be held, particular attention being devoted to the fire waste and its reduction and also to suburban home building in addition to the great architectural, engineering and building achievements of the present day.

Concrete and Reinforced Concrete in the American Society of Civil Engineers

At the fifty-ninth annual meeting of the American Society of Civil Engineers, the committee on concrete and reinforced concrete, which forms a portion of the well known joint committee, reported that in five meetings during the past year, a number of modifications had been made in the original report. These modifications had been submitted to the various other societies comprising the joint committee, which had promised up to a few weeks ago to be ready in time for this annual meeting. As this was not now ready to be presented, the committee presented a progress report and stated that it hoped to be able to bring out its final report soon.

OBITUARY

Edwin C. Griffin

Edwin C. Griffin, inventor and manufacturer of cement grinding machinery, died on December 10, 1911, in Boston. Mr. Griffin, who was a native of Ontario, Canada, was born January 29, 1848. Owing to the importance of his inventions, chief among them the Griffin mill, he was as well known in the cement industry, both at home and abroad, as one of the leading manufacturers of cement. Mr. Griffin was a son of the late James K. Griffin, inventor of the original single roll mill that bore his name. The father died about a year ago at the advanced age of ninety years.

As stated, the family has long been identified with the cement industry. The early single roll Griffin mill was invented by the elder Griffin. Its first use was in connection with grinding phosphate rock, and the first time its possibilities for clinker grinding were considered when it was inspected by John W. Eckert and Robert W. Lesley, of the American Cement Company, who saw it in operation in a fertilizer works near Boston. They were so much impressed with the success of the mill as a grinding machine that they at once ordered one, which was installed at the plant of the American Cement Company at Egypt, Lehigh county, Pennsylvania. This mill required all sorts of attention and all kinds of changes before it was finally perfected for the grinding of clinker; but from this small beginning the great growth in the cement industry arose. Edwin C. Griffin, who was the active man of the Bradley Fertilizer Company—the concern which then owned the patents—was largely instrumental in perfecting the mill. For the past twenty years he devoted his time and energy to the development of the Griffin mill, making many improvements, keeping it prominently before the industry in this country and also aiding in its introduction abroad.

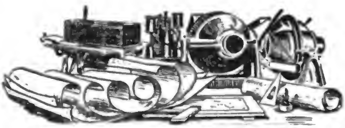
Aside from the success that attended the manufacture of thoroughly reliable and excellent machinery, Mr. Griffin personally enjoyed the esteem and friendship of all who knew him. He had an extensive acquaintance in engineering and scientific circles as well as among those representing the manufacturing side of the cement industry. His pleasing personality, high character and integrity combined to make him a conspicuous figure in industrial and commercial fields, and the announcement of his death was received with deepest regret by his many friends.

Charles H. Ramsey

Charles H. Ramsey, director of the Helderberg Cement Company, died suddenly at his home at Albany, N. Y., on Christmas night. Mr. Ramsey appeared in the best of spirits in the morning and as he exchanged Christmas greetings with the other members of his family he seemed to be enjoying good health. His sudden death was a great shock to his family and friends.

Mr. Ramsey was the son of the late Joseph H. Ramsey, former senator and president of the Albany and Susquehanna railroad. Mr. Ramsey was 59 years of age, and was born in Lawyersville, N. Y. He was one of the organizers of the Howe's Cave association and was also one of the organizers of the Helderberg Cement Company.

Mr. Ramsey had an extensive acquaintance among those prominent in the cement and allied industries and the announcement of his death was received with deepest regret.



PATENTS

In order to keep the readers of CEMENT AGE *in touch with the progress that is being made along the lines of invention in the cement industry of the United States, a list of patents granted by this Government will be published monthly. No attempt shall be made to describe any patent in detail or to publish any diagrams in this department; patents that cover vital points will be treated in the regular editorial columns if their importance warrants. Rather it is the purpose of this list to keep the reader posted in the principal inventions that are of interest and value; detailed information will be furnished on request to* CEMENT AGE.

Illustrations and specifications of any of the patents mentioned in this department will be forwarded on receipt of 25 cts. to cover costs. Address Royal E. Burnham, 857 Bond Building, Washington, D. C.

1,012,016. Marbleizing artificial stone. August Riesch, Cincinnati, Ohio.
1,012,152. Reinforced concrete railway-tie and rail-securing means. Earle R. Pollard, Los Angeles, Cal.
1,012,419. Concrete fence-post. Jacob Offenhauser, Sacramento, Cal.
1,012,423. Sectional concrete telegraph-pole. William J. W. Orr, Anaheim, Cal.
1,012,467. Process of producing cement and products thereof. Arthur C. Spencer, Washington, D. C.
1,012,612. Concrete land-roller. Joseph M. Da Vier, Disco, Ill.
1,012,729. Concrete-mixer. Isaac K. Shero, Okemah, Okla.
1,012,735. Mold for concrete steps. Jasper K. Smock, Terre Haute, Ind.
1,012,750. Dam. Frank Stone Tainter, Far Hills, N. J., assignor to Power Development Company, Hoboken, N. J.
1,012,832. Method of bending concrete. Sylvester W. Flesheim, Cleveland, Ohio, assignor to The Master Builders Company, same place.
1,012,863. Concrete grave-vault. George H. Killian, Hicksville, Ohio.
1,012,868. Concrete fence. William S. Laney, Lithopolis, Ohio.
1,012,893. Mausoleum. Thomas J. Moore, Richmond Hill, N. Y.
1,012,942. Tie. James T. Wade, Brandy, Tex.
1,013,009. Reinforcing-frame. George M. Graham, Chicago, Ill., assignor, by mesne assignments, to Suspension Steel Concrete Company.
1,013,038. Construction of buildings. John Mitchell, Ponsonby, New Zealand.
1,013,039. Concrete post. William H. Moore, Victor, Colo.
1,013,109. Machine for mixing concrete and the like. Charles E. Bathrick, Chicago, Ill., assignor to Frederick C. Austin, same place.
1,013,251. Mold for making hollow concrete columns. Charles H. Witthoefft, St. Louis, Mo., assignor to Witthoefft Collapsible Concrete Forms Company, same place.
1,103,302. Reinforced concrete pipe. Vladimir V. Messer, Los Angeles, Cal.
1,013,385. Building construction. Thomas J. George, Englewood, N. J.
1,013,395. Railway-tie and rail-fastening. Jacob Alvin Hyle and Joseph Alexis Pement, Chicago, Ill.
1,013,398. Staple-anchor. William L. Keller, Kearney, Neb.
1,013,407. Concrete block and wall. Lyman G. Lease, Howland, Ohio.
1,013,475. Apparatus for molding concrete walls. Theodore H. Brown, Minneapolis, Minn., assignor to Nels J. Blomgren, same place.
1,013,480. Concrete construction. Thomas Fellows, Los Angeles, Cal.
1,013,536. Concrete-block machine. Charles E. De Forrest, Lima, Ohio.
1,013,537. Fireproof floor and ceiling construction. Johan G. Eifler, New York, N. Y., assignor of one-third to Ernst Ebbinghaus, same place.
1,013,578. Fence-post. Harry F. Abbott, Jackson, Mich.
1,013,591. Means and apparatus for concrete construction. William C. Edwards, Jr., Kansas City, Mo.
1,013,592. Reinforced concrete structure. William C. Edwards, Jr., Kansas City, Mo.
1,013,632. Form and mold for making concrete buildings. Charles H. Witthoefft, St. Louis, Mo., assignor to Witthoefft Collapsible Concrete Forms Company, same place.
1,013,655. Railroad-tie. Ulysses Grant Hamilton, Peters, Cal., assignor of one-fourth to Louis Frederick Sanguinetti, same place.
1,013,660. Water-conduit. Gustave Kaufman, New York, N. Y., and Coleman Meriwether, Montclair, N. J.
1,013,698. Frame for reinforced concrete structures. Armen H. Tashjian, Portland, Me.
1,013,736. Railway road-bed, track, and rail construction. John N. D. Brown, Anarko, Okla.
1,013,954. Method and machine for making cement sewer-pipe. Robert Lee Rickman, Vancouver, British Columbia, Canada.
1,014,015. Lime-kiln. Nelson E. McLoon, Glencoe, Mo.
1,014,085. Concrete-tie. Alvus H. Moffet, Larned, Kans.
1,014,086. Rail-fastening. Alvus H. Moffet, Larned, Kans.
1,014,087. Rail-fastening. Alvus H. Moffet, Larned, Kans.
1,014,088. Rail-fastening. Alvus H. Moffet, Larned, Kans.
1,014,089. Tie-structure. Alvus H. Moffet, Larned, Kans.

Cement Age

A MAGAZINE DEVOTED TO THE USES *of* CEMENT

with which is combined

Concrete Engineering

VOL. XIII 14 MARCH, 1912 NO. 3

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CEMENT AGE

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VOL. XIV MARCH, 1912 No. 3

THE MARCH ISSUE

A CONCRETE BRIDGE AT KANSAS CITY represents typical highway bridge construction. Timber centering, pile supported, was used. An interesting feature of the centering was the clear flood-way in the center made by carrying the middle section of the arch centering on structural steel girders taken from the former bridge. The railing for the bridge is concrete, cast in panels.

REINFORCED CONCRETE FOR ORE DOCKS is becoming the standard material. In this instance the dock is all on made ground, over comparatively deep water. Concrete piles, cast vertically, support the outer dock wall, and against this piles from the bottom up, are laid horizontally concrete sheathing timbers which hold back the rip-rap fill. The dock for the unloader, the ore trough, and the distributing bridge sub-structure complete the work.

STRUCTURAL DETAILS OF SKELETON FRAME CONSTRUCTION covers some of the construction problems involved in the type of building described in the February issue. Centering methods are described in detail.

ELECTRIC EQUIPMENT OF A GERMAN CEMENT PLANT presents an interesting discussion of power methods abroad. The change in modern methods of Electric drive, in comparison with present day installations, is pronounced.

MECHANICAL HAULAGE of materials is involved in all construction work. The use of steam tractors and trailers is discussed in comparison with other power.

TRIPS FOR STEAM SHOVEL DIPPERS have been extensively studied on the Panama Canal work and this article presents an interesting résumé, and a detailed discussion of present methods.

R. I. HUMPHREY ADDRESSES THE BRITISH CONCRETE INSTITUTE on the subject of Fire Prevention. The address illustrated with lantern slides reviewed vividly the progress of fire-resisting construction.

CONSULTATION discusses *Solid or open Spandrel Construction, The Storage of Explosives,* and *Bank Vault Construction.*

CORRESPONDENCE continues comment on the *Quantity Surveyors,* discusses the *Control Beam,* and *"Concrete Terrazo."*

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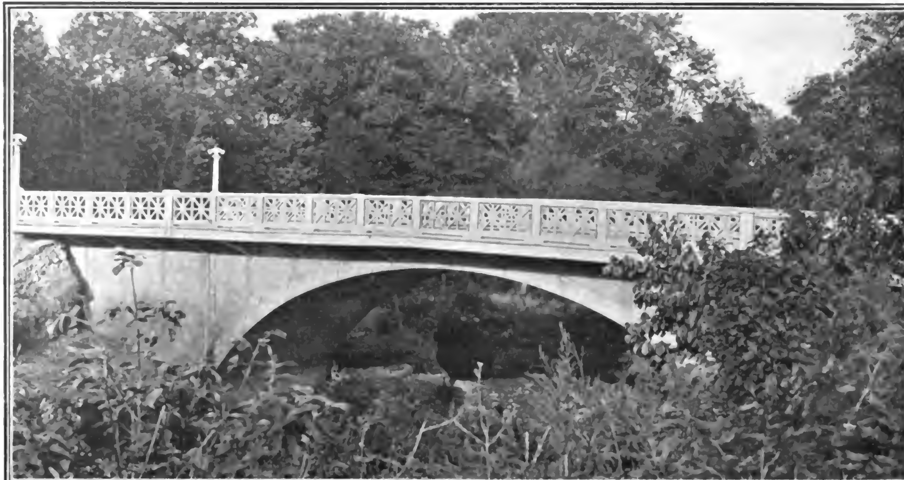


A REINFORCED CONCRETE BRIDGE CARRYING CLEVELAND AVENUE OVER BRUSH CREEK, KANSAS CITY, MO.

A solid spandrel arch with a clear span of 72 ft. The railing and light standards are of cast concrete. Detailed description of this structure is published on page 121 of this issue.

CEMENT AGE with which is combined CONCRETE ENGINEERING

A Monthly Magazine Devoted to the Uses of Cement and Concrete

VOL. XIV MARCH, 1912 No. 3

REINFORCED CONCRETE OR STEEL FRAME

FROM 1906 to 1908 the German production of rolled steel sections dropped from 1,200,000 tons to 830,000 tons. Although this production rose to 1,045,000 tons in 1909, there has been much feeling among the steel men against concrete, and at a recent meeting of German steel men a paper was presented on the comparative value of reinforced concrete and steel frame structures. This paper was by inference, an attack on reinforced concrete, and called for a reply by the Council of the German Concrete Association, which has been published in some of the German technical journals.*

It must be recognized that the advance of reinforced concrete over steel is not due to its lower cost, but to those actual advantages over steel which it possesses. Under fire attack, unprotected steel softens, and is a dangerous structural material. Concrete-steel, on the other hand, is the one real fire resisting structural material. From the slower oxidizing process, such as rust, concrete is essentially an effective protection for steel.

The steel men should realize that, while there might possibly be a decrease in tonnage of rolled structural sections, yet with the greatly increasing production of steel reinforcing rods, the apparent decrease is in a way only a change in the section of steel rolled. And reinforced concrete has, to such a great extent, replaced heavy masonry in dams, bridges, retaining walls, foundations, etc., and it has also created and met a demand for *better construction* on every hand, that the total production of structural steel is probably greater now than at any time.

The German paper above referred to, attacks structural concrete on the ground that, to put it bluntly, the engineers who use it do not understand its statical properties, or how to use it. There are two replies to that statement. It is hardly two years ago that a series of experiments on standard steel sections, reported to the American Society for Testing Materials, disclosed the startling fact that everything was not known about the properties of structural steel shapes.

On the other hand, CEMENT AGE presented a year ago a complete description of a detailed analytical research to determine the stresses in a completed concrete building under actual load. Our readers are familiar with the methods used. It may be of interest, however, to note further that the same methods of analytical research have been applied to a beam and slab floor,† as well as other flat slab floors. There is something intensely practical about placing reinforcing steel in the mold, the matrix of a great floor and its supporting columns. The steel is placed and held in place where, according to our best understanding, it will meet the tensile stresses. Around this steel is poured the concrete, liquid stone. And then, with the work finished and the test load on, to attach to the steel rods and the concrete at the determining localities, instruments which will indicate the stresses that each element is sustaining, real work done under real loads. Could anything be more practical or direct? It remained for concrete engineers to design and apply the most complete and highly developed analytical testing methods of the structural engineering world. And a German steel man can say that the statical design of concrete is obscure.

The strongest grounds for criticisms of concrete yet remains, we believe, in the problems of the field, the intelligent and effective execution of the design. A rolled steel unit fabricated in the shop, goes onto the work ready to put into place. A timber beam also is ready to be put into place. Not so, however, with our field-made concrete beam. The form builder determines the size. Upon the man bending and placing steel depends its effective depth, and other essential features. The man behind the mixer has a hand in the real value of that concrete. The man on the floor spading is a factor in the ultimate value of the finished concrete. Despite this, a concrete girder, the product of so many factors, stands unrivaled as an engineering element. With comparatively so many chances for error, the inherent value of the material, and its rapidly growing intelligent and appreciative use, have nevertheless placed it in the forefront of the world's engineering materials.

German steel men would probably do well not to push this question further. In this country, with probably some exceptions earlier in the development of concrete, the steel men have been content to let matters take their natural course and "go in" to get what work they could, recognizing that we are in a great era of better construction, the dominant note of which is concrete construction. Attacks of rival interests cannot stop the progress of this material.

*A review of this will be found in "Foreign Notes" for this month, page 156.

†A paper on this series of tests will be presented at the Kansas City Convention of the National Association of Cement Users.

FIRE INSURANCE COMPANIES THAT BELIEVE IN CONCRETE

WE frequently hear it said that fire insurance companies are not altogether satisfied concerning the virtue of cement and concrete as fire-resisting material. As throwing some light on the real situation attention may be called to the fact that the Continental Insurance Co. and the Fidelity Phoenix Fire Insurance Co., of New York, used a half-page in *The Sun* (New York) of February 6, announcing that the new Fire Companies Building would be ready for occupancy on April 1. We quote the following paragraph from the advertisement:

Three enclosed and absolutely non-combustible stairways from ground floor to attic. All steel columns encased in solid concrete. Concrete floors. Basement and sub-basement equipped with automatic sprinklers. The kind of fireproofing which succeeds and protects. Not "fireproof" in name only, but based on the practical knowledge and experience of fire insurance companies."

We fail to find anything in this calculated to inspire doubt on the subject of cement. On the contrary specific mention is made of cement and concrete as valuable fire-resisting materials. All columns are encased in solid concrete and floors are made of cement. The building is 25 stories and contains 8 acres of floor space. It is located in the center of the insurance district.

MECHANICAL HAULAGE

ALL building material, practically without exception, has to be transported to the construction site. Probably the only exception to this is a case where a concrete structure is erected with aggregate secured on the site. The only hauling in such a case would be the cement, steel, lumber and equipment. In many cases, freight cars can be run directly on to the job, and unnecessary handling avoided; but in the bulk of the work, buildings especially, the material has to be hauled. In this connection, a discussion of mechanical haulage on other pages of this issue, is of peculiar interest. A point made in this discussion, which might well be emphasized, is the extensive and common use in Great Britain, and Europe of a very elemental method of mechanical haulage, namely, a steam tractor and trailers. That this custom is established abroad is apparent to the traveler, who notices even in the congested districts of London, a tractor and trailer, moving through the streets, and exciting no comment whatever. Any suggestions, as in the article referred to, to apply such methods in this country, has behind it the support of many years experience abroad.

Another point to be emphasized is, that with the mechanical equipment as at present available, steam tractors are only advocated for handling the heaviest materials on hard hauls without stops. The development of motor trucks during the past few years has been wonderful, and without precedent, evidencing that a great demand existed for transportation methods better than horse haulage. Tractor equipment seems to offer a medium, happy it may prove, between railroad and motor truck, handling "near freight" loads, and following, with the motor truck, the highways of the country.

This suggestion of steam tractor haulage has another immediate bearing on the good roads question. With concrete highways furnishing excellent road beds to every community of the country, and tractors handling any commodities at a low ton-mile cost, we can see the possibility of an awakening in commercial intercourse. The value of a gravel or sand bank, say fifty miles from a city, would not depend upon its adjacence to a railroad siding. A concrete road would then be "every man's railroad."

EXTRAS AND QUANTITY SURVEYING

WE quote from a letter published on other pages of this issue under the title "The Quantity Surveyor."

"If he (the architect) requires the successful bidder to deposit on signing the contract, a priced copy of the schedule of quantities, he has a definite basis for adjustment of variations and extra work, which are often a source of friction and trouble to all parties."

This it seems to us would be a most valuable factor in helping solve our ever-present problem of extras. It is a suggestion, too, which should be applied more broadly under present conditions, without waiting for any practice of quantity surveying. Putting a definite unit valuation on every operation upon signing the contract would make unnecessary many subsequent misunderstandings which are such a potent source for "friction and trouble."

The Equitable building was fireproof, one of the oldest in the city, to be sure, but relatively as fireproof as much younger buildings. The exterior walls were of massive construction—stone backed with brick—and self-supporting. The floors were of brick and flat tile arches in steel beams and supported by cast-iron columns, all unprotected. The top flooring was largely of wood, likewise trim and many partitions. No effort was made to protect floor openings. Why should there be? It was a "fireproof" building.

A CONCRETE BRIDGE AT KANSAS CITY

A HIGHWAY bridge carrying Cleveland avenue across Brush Creek, Kansas City, has recently been completed. The bridge though small, is a typical concrete structure, and an artistic example of what can be done with this material. Waddell and Harrington, of Kansas City, were the designing engineers.

The bridge is 133 ft. over all, and has one 72-ft. arch. The paved roadway is 26 ft. wide with two 7-ft. sidewalks. The abutments are on bed rock, 40 ft. below roadway. The hand rail and light standards are concrete. The H. B. Thompson Co., of Kansas City were the contractors, and we have from them, through the courtesy of Waddell and Harrington, the following notes on the work:

The old 80-ft. span, light steel truss bridge, was taken down carefully by means of light false work and guy pole, and the old masonry foundations were dynamited. The stone was loaded into boxes, hoisted and swung by derrick along side of a portable crushing plant. All the rock in both abutments was crushed at site and used as concrete aggregate.

The foundation pits were carried down through black soil, gravel, blue clay, hard pan and approximately 4 ft. into hard blue soap stone, that required blasting to remove. The excavation was done by means of shoveling into boxes in the pits—boxes being lifted and swung by derrick and hoisting engine. The south abutment pit was carried down with very little pumping required and no casing. The north abutment was sheeted with 3-in. x 12-in. oak plank around two 6-in. x 8-in. casing ribs, shored across the pit every six feet. This foundation pit required considerable pumping, but it was not necessary to use a power pump.

On reaching suitable foundation in the pits, forms were built, reinforcing rods placed and concrete poured forming the abutments up to the spring line of arch.

The centering for the arch consisted of four pile bents of four piles each, and two center pile bents of five piles each. These bents were capped, top of caps being elevation of spring line of arch, and four lines of 6-in. x 8-in. stringers were placed continuous from abutment to abutment, the ends, at elevation of the spring line bearing 4 in. on the concrete abutments. At completion the ends of stringers were bored out and the holes in the abutments filled with concrete. On these four lines of stringers, were placed a set of pine wedges over each pile, there being four and five sets of wedges to each bent; 3-in. x 12-in. timber was laid on the wedges over each bent through the width of the arch. On these 3 x 12 timbers, the arch bents were erected, each having four and five 6 x 8 vertical posts *V* braced, with 6 x 8 caps set edgeways, top of caps 12 in. below intrados of arch. On these caps were placed 2 x 12 ribs, dapped to take square bearing on caps. These ribs placed 18 in. centers across the arch and were cut from timber of sufficient dimensions to make them lap over alternate caps. The ribs were covered with 2-in. planking to form the intrados of the arch.

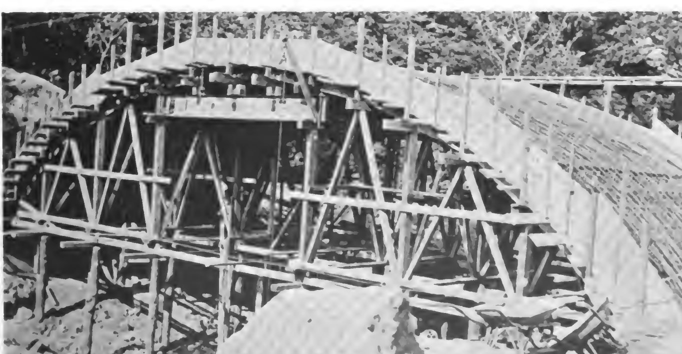


FIG. 1—THE CLEVELAND AVE. BRIDGE, KANSAS CITY, DURING CONSTRUCTION. Note the structural steel girder carrying the center of the span, to allow for flood.

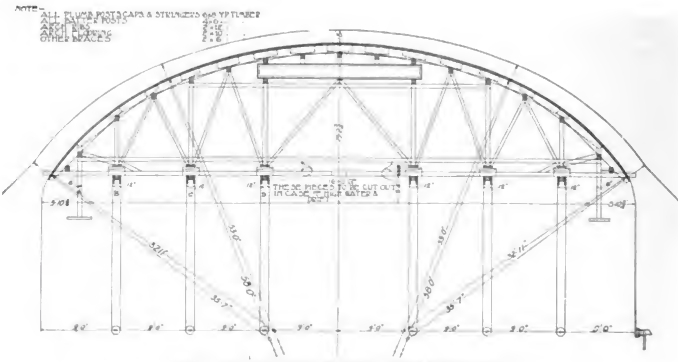


FIG. 2—ELEVATION OF THE CENTERING USED.
Note the clearway in center. Compare Fig. 1.

A very simple and accurate method of laying out the ribs, was done by laying out the full size arch intrados radii on a level place near the bridge site. The timber for the ribs was, therefore, marked by a full size drawing. Probably the most interesting feature of this arch centering was the simple straight work giving maximum strength and maximum safety in every respect at the lowest cost. The five steel floor beams of the old bridge were utilized to make an 18-ft. clear opening of maximum height in the centering. This was economical, as it saved one pile bent and one centering bent, but its main purpose was to allow drift to pass through in case of high water during construction.

The design of the arch reinforcement is especially good. The stirrup rods were bent around pins, set on a horizontal plane, the pins conforming to exact cross sections of main bars. The top reinforcing bars were laid on the arch form first; the stirrups were then placed in position, the top arch bars raised and wired to stirrups, the bottom bars then placed in stirrups, wired thereto, then the cross straight bars, both bottom and top, were placed across main bars. The entire reinforcement was

FIG. 3—DETAIL VIEW OF BRIDGE DURING CONSTRUCTION.
An ingenious steel stirrup arrangement was used.

held above bottom of form by means of small concrete blocks.

The equipment and material was gotten ready and the concrete in the arch ring was poured continuously until completed. It was necessary to put a top back- form on the arch ring about one-half the length of the arch, beginning at spring line.

After the spandrel and wing walls and cantilevered side walks were completed, the earth filling between the wing walls and over the arch was placed. In order to get this fill thoroughly settled, on which to lay a creosoted block pavement, the earth fill was treated with a water jet, the steam pump pressure giving about 75 lb. water pressure through a 2-in. jet, which was forced into the fill until the whole was thoroughly settled; it was then allowed to drain and dry out for two months, was then rolled and tamped; the concrete base and creosoted block pavement then put on.

The entire railing was manufactured in the field, the Greek cross panels being cast in units on a horizontal plane. The forms consisted of a wooden base 6 in. wider and longer than the concrete panel. A wooden rail the thickness of the panel was bolted around the outer edges of this base, the measurements between the rails being the size of the panel, on this base was also bolted triangular blocks, split in half horizontally, with a sight bevel or draw to each half; these blocks were bolted together and bolted to the base in place to form the triangular openings of the Greek cross design of the panel. After the forms were bolted together the base was laid level horizontally on two horses or bents, about 3 ft. above the work floor level; the form was then filled with water and allowed to soak over one night; the following morning the water was let out, the form cleaned and re-leveled, ½-in. of concrete was put in bottom and well tamped with small hand tampers. one set of reinforcing wires were placed, then 3 in. more concrete was put in, well tamped and second set of reinforcing wires was then placed

FIG. 4—THE UPPER VIEW SHOWS AN APPROACH OF THE FINISHED BRIDGE. BELOW IS SHOWN A FINISHED PANEL OF THE RAILING.

and concrete finished to the top and struck off with a straightedge run over top of outer railing and triangular blocks, all of which were made the exact thickness of the panel. After the concrete was sufficiently set the top was finished with smoothing trowel. Concrete in the panel was allowed to stay in the form undisturbed three days; the outer railing of the form was then removed and the base

FIG. 5—THE FINISHED BRIDGE.

to which the triangular blocks were bolted and on which the concrete was resting, was set up on edge, the panel resting on a piece of timber on the ground. The blocks were then unbolted from the base and the base removed. Forty-eight hours from the time the base was removed, the triangular blocks were removed from the concrete panel by taking one-half of the block out from one side and the other half from the opposite side, the slight bevel and shrinkage of the blocks allowed them to be removed without injury to the edges of the concrete.

The equipment used was a double cylinder double drum hoisting engine; one five-ton stiff leg derrick; one five-ton guy derrick; two No. 1 steam-driven Smith Concrete Mixers; one steam-driven water pump; one portable stone crusher; complete with elevator and screen, driven by portable gas engine. There were on hand a 4-in. Emerson steam foundation pump and a 6-in. centrifugal pump in case of necessity in the foundation pits.

The structure includes about 1,000 cu. yds. of concrete, 33 tons of steel, and about 400 sq. yds. of creosoted block pavement. The total cost to the city was about $16,000, including the removal of the old steel span.

Effect of High Pressure Steam on Cement Mortor and Cement

The Bureau of Standards, Department of Commerce and Labor, sends out under technologic papers Bulletin No. 5, entitled "The Effect of High Pressure Steam on the Crushing Strength of Portland Cement Mortar and Concrete," by Rudolph J. Wig, Associate Engineer-Physicist. The investigation reported was made in the Technologic branch of the United States Geological Survey at the Structural Materials Testing Laboratories, St. Louis, Mo., of which Richard L. Humphrey was engineer-in charge. The work of these laboratories was transferred to the Bureau of Standards July 1, 1910. The present paper, written since that time, was prepared from the uncollated data then transferred.

There were two series of investigations: 1. To determine the effect of different steam pressures on the hardening of Portland cement mortars. 2. To determine the effect of duration of steam exposure on the hardening of Portland cement mortars.

After describing the specimens, apparatus and tests in detail, the following summary is given, based, of course, on materials similar to those used on this occasion, but as the specimens were of sufficient size and number to make results reliable and accurate, the tests will be of value in practical work:

Steam up to 80 lb. per sq. in. gauge pressure has an accelerating action on the hardening of Portland cement mortar and concrete.

The compressive strength increases as the steam pressure is increased.

The compressive strength increases with the increase in the time of exposure to steam.

A compressive strength considerably (in some cases over 100 per cent) in excess of that obtained normally after aging for six months may be obtained in two days by using steam under pressure for curing the mortar.

Steam under pressure, if of sufficient duration, permanently accelerates the hardening of the mortar, giving subsequent constant increase in compressive strength with age.

The steam-cured mortar or concrete is of much more uniform appearance and much lighter in color than normally aged mortar or concrete made from the same materials.

The mortar or concrete should obtain an initial set before it is exposed to the steam treatment.

For steam curing a "quaking" or medium consistency is preferable to a very dry or a very wet consistency.

The initial modulus of elasticity and the yield point of the mortar increase directly with the duration of steam treatment.

The initial modulus of elasticity and the yield point of the mortar increase directly with the steam pressure.

The initial modulus of elasticity does not increase in direct proportion to the increase in the ultimate compressive strength of the steam-cured mortar.

Results indicate that the compressive strength obtained by steam curing is directly proportional to the cement content of the mortar.

Cause and Prevention of Concrete Failures

[From Engineering News.]

It is a peculiarity of the failure of every concrete structure, where the primary fault is in the design or construction of the concrete or of its reinforcement, that a very apparent cause can soon be found, and that that cause is one which should have been apparent to anyone claiming more than an elemental knowledge of the science of building in concrete.

With a regularity almost monotonous we read of insufficient reinforcing connections, of improperly mixed concrete, of frozen material, of thin supporting struts, and of premature removal of forms, until we wonder what is the nature of men who will not learn the fundamentals of a business at which they hope to earn their living.

There does not seem to be any good reason why the concrete building business should not be conducted in the same manner as the building of steel structures. Why should not every architect be competent himself or have associated with him an engineer competent to design the concrete structure? Why should not this expert prepare the general structural drawings for the building upon which competent contractors may bid? Once the bid is awarded, taking into account both the competency of the bidder and the prices bid, the successful contractor could himself prepare the detail plans showing method of erection, minor steel details, etc., exactly as the steel companies now prepare shop drawings showing erection methods and connection details for the approval of the designing and supervising engineer of a structural steel building. This would remove the commercial element from design and would surely tend toward safer buildings. Such methods are very generally in use, and the buildings so erected are of the class which make the reputation of reinforced concrete as a building material.

REINFORCED CONCRETE IN ORE DOCK CONSTRUCTION

THE present ore handling facilities of the Pennsylvania Company in the City of Cleveland are located on a branch of the Cuyahoga River on property known as Whiskey Island. This property is located to the south of the main line of the Lake Shore & Michigan Southern Railway. The channel to the docks of the Pennsylvania Company is very crooked and, in addition, is spanned by three bridges, one of which is the single track swing bridge which carries all the main line traffic of the L. S. & M. S. Ry. and the dock business of the Pennsylvania Company. The movement of boats to the docks is a very tedious one, requiring the services of one or two tugs, and it is only by reason of cutting off corners that the large ore boats have been able to reach the docks. For this and other reasons, the Pennsylvania Company decided to develop its property in the Lake Front, located on what is known as the West Breakwater.

The work undertaken consists of the reclaiming of land by filling and protecting same by rip rap walls, construction of a dock, foundations for ore unloaders and bridge, erection of the ore handling machinery and power house to operate same, providing a system of electric locomotives for handling cars under the machines, construction of a double track subway under the seven tracks of the L. S. & M. S. Ry., and a complete track development. An area of approximately 40 acres has been reclaimed by filling with slag and other refuse collected on the Cleveland & Pittsburg Division of the Pennsylvania System.

FIG. 2—DETAIL PHOTOGRAPH SHOWING REINFORCING STEEL IN PLACE FOR DOCK WALL. This is the reverse view of Fig. 1.

DOCK.—The dock is 985 ft. over all in length and consists of a double row of 40 ft. reinforced concrete piles, spaced 3 ft. on centers, supporting a concrete superstructure heavily reinforced with 85 lb. rails. Reinforced concrete struts, spaced 30 ft. on centers and supported on reinforced concrete piles 30 ft. long, unite the dock face with the foundation walls for the rear leg of the unloaders. This wall, which is parallel to and approximately 75 ft. distant from the dock face, is supported on three rows of reinforced concrete piles 30 ft. long, spaced about 4 ft. on centers. Small rip rap stone was

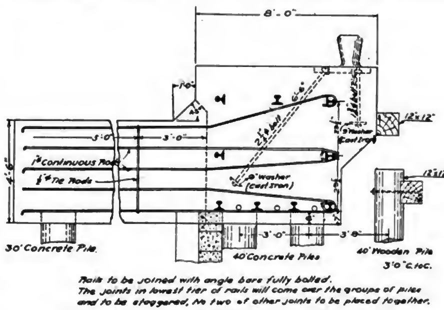


FIG. 1—DETAIL SECTION OF OUTER DOCK GIRDER SUPPORTED ON CONCRETE PILES.

The horizontal concrete sheet piling, to hold the rip-rap fill, shows in section.

deposited around these piles and the concrete laid, using the rip rap as a base. Reinforced concrete sheet piling, 10 in. x 12 in., were laid horizontally between the two rows of piles supporting the dock face, and the space between the rear wall and dock face was filled with rip rap stone, varying in size from shovel to derrick size, a temporary wooden trestle being used from which to handle the stone with a locomotive crane. After the rip rap was brought up to the lake level, the whole mass was pumped full of sand by means of a hydraulic dredge.

The dock face is protected by wooden piles tied together with a 12-in. x 12-in. oak waling streak.

Rip rap was also placed immediately back of the rear wall and sand pumped into same to form a support for a U-shaped trough. The bottom of this trough is protected by steel rails, laid so the top of the head is flush with the bottom of the trough.

PILES.—The first work done in the construction of the dock was the manufacture of the piles. The contractors' Cleveland property is located in the West Breakwater and the piles were made there. The piles, octagonal in shape, reinforced with eight 1-in. steel rods securely bound with 3/8-in. steel

FIG. 3—GENERAL VIEW OF CONCRETE ORE-DOCK CONSTRUCTION. AT THE EXTREME LEFT IS SHOWN THE DOCK FACE WALL OF FIGS. 1 AND 2. IN THE CENTER IS SHOWN THE ORE-TROUGH.

Note the two mixer plants on cars with adjustable chutes. The ore-unloaders are being erected at the left, and the scaffold for the ore bridge at the right.

rods, were cast vertically in steel forms, a cast-iron shoe being fitted into the form and becoming a part of the finished pile. A 1:2:4 mixture of both gravel and broken stone was used. All material entering into the construction of the piles was received in cars and handled by a locomotive crane. As most of the piles were made during January, February and March, the material as well as the finished piles, were kept heated.

Tunnels, formed by interlocking steel sheet piling, were placed under the piles of sand, gravel and broken stone, and the steam pipes were placed in the elevated bin used in connection with the mixer. The water was also kept heated in this manner

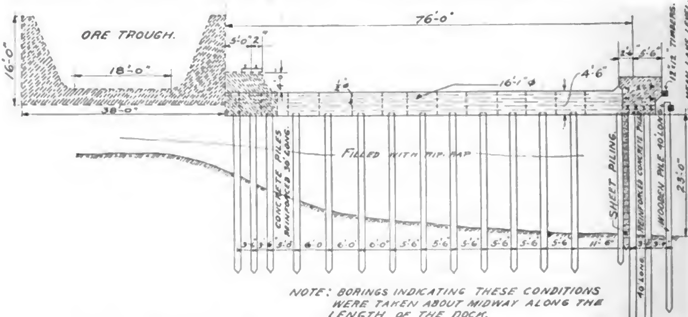


FIG. 4—SECTION SHOWING ORE TROUGH AND DOCK CONSTRUCTION.

Note that this is the reverse of Fig. 3. The horizontal sheet piling are shown in section at the right.

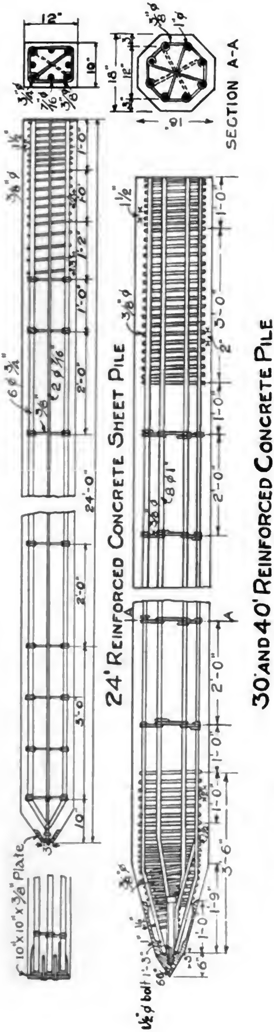


FIG. 5—LONGITUDINAL AND SECTIONAL DETAILS SHOWING REINFORCEMENT FOR CONCRETE PILES.

FIG. 6—ABOVE IS SHOWN THE TOWER AND PLANT FOR POURING PILES.
All piles were cast vertically in steel forms.
BELOW IS SHOWN THE REINFORCING FRAMES READY FOR POURING.

After the forms were filled, they were laid on skids, covered with tarpaulin and live steam allowed to circulate around them. The forms were removed in from 12 to 24 hours after pouring, depending on the weather, but the piles were kept covered and heated for a considerable time after the forms had been removed. The number of piles manufactured was:

625 40-ft. octagonal.	120 24-ft. octagonal.
2647 30-ft. octagonal.	120 20-ft. octagonal.
932 24-ft. 10-in. x 12-in. sheet piles.	
210 28-ft. 10-in. x 12-in. sheet piles.	

FIG. 7—DRIVING CONCRETE PILES ON LAND

Different stages in up-ending the pile in the leads.

Each pile was numbered and a record kept of date of manufacture, so as to guard against any pile being driven before it was at least 30 days old. As a matter of fact, the driving was delayed on account of ice in the harbor and no trouble was experienced with green piles.

Piles were loaded into scows by a locomotive crane and towed to the site, where they were driven by floating pile drivers, no particular devices being used to protect the head of the pile other than an oak driving block. The greater number of piles were put down without a great deal of hammering, but there were individual cases requiring heavy hammering; for instance, a 30-ft. pile required 111 blows of a 5000-lb. hammer, falling 3 ft. 6 in. for the last foot. Another 30-ft. pile required 440 blows of 3000-lb. hammer, falling 3 ft. These piles did not suffer any appreciable damage, except at the top in the part to be buried in the concrete superstructure. The piles drove to a very good line, as shown by the photographs. No particular difficulty was encountered in the construction of the concrete superstructure, and the method of constructing forms, placing reinforcement, and pouring concrete is illustrated by the photographs.

WALLS AND TROUGH.—About 3,500 cu. yds. of concrete were placed in the dock, struts and unloader walls. The bridge walls are supported on piles also, but the superstructure was placed after the filling had been made. The mixer was placed on a railroad car and supplied with material from cars on the same track, laborers handling the material with wheel barrows. The concrete was hoisted in a bucket and deposited in the wall through a chute. 5,900 cu. yds. of gravel concrete, united in proportion 1:3:6 being placed.

The dock work, including the manufacture and driving of all concrete piles, was done by The Great Lakes Dredge & Dock Company. This contractor also constructed the foundation for power house and the sub-structure for Hickory Street crossing.

The concrete in the trough wall was placed in the same manner and proportions as for the bridge walls, 9,000 cu. yd. being placed. This ore trough was constructed by the Dravo Constructing Company.

The ore unloaders operate on tracks located on top of the dock and rear wall, while the tracks

FIG. 8—THE CONCRETE PILE ABOUT READY TO BE DRIVEN.

FIG. 9—DRIVING CONCRETE PILES FROM A SCOW.

for the bridge are on the separate walls. One hundred-pound rail was used in these tracks, supported on oak ties 3 and 4 ft. long, every third tie being held in place by a 1-in. drift bolt set 1-ft. 5 in. in the concrete. Special tie plates and clips, fastened with screw spikes, were used on every tie.

UNDERGRADE CROSSING.—In order to reach the dock, it was necessary to cross the main line of the L. S. & M. S. Ry. This has been effected by raising the Lake Shore tracks 4 ft. and constructing a double track undergrade crossing at Hickory Street. This crossing has very heavy reinforced concrete walls supported on concrete piles. The floor is of heavy *I*-beam, encased in concrete construction, with supporting row of columns at the center of the span. This structure carries the seven tracks of the L. S. & M. S. Ry., and, as but two of these tracks could be abandoned at a time, the subway had to be built in short stretches, working from south to north, the overhead tracks having been carried on pile trestle during the progress of the work.

We are indebted to R. Trimble, Chf. Engr., Maintenance of Way, Pennsylvania Railroad for notes and photographs on this work.

Removing Forms

The time that forms have to remain in place depends upon the character of the members, whether conditions, the span, if a beam or slab, and the relation of the dead to the live load.

A Concrete Lighthouse

[*From Engineering Record.*]

A reinforced concrete lighthouse on a concrete crib foundation has recently been completed at Huntington Bay, Long Island. The structure is located on a bar at the entrance to Lloyds Harbor and is equipped with a revolving light. The foundation is a reinforced concrete crib 26 by 30 ft. in section and 16 ft. deep. The methods employed in the design and construction of this crib were described in the *Engineering Record* of November 19, 1910. This crib is protected by rip rap and carries a concrete deck on which the superstructure is built. This building is of the ordinary pilaster and wall slab construction and contains the living quarters for the lighthouse keeper. It is covered with a flat roof around which is placed a concrete parapet wall. The light tower, although an integral part of the building, is built monolithically and has a square outside section 10 ft. on a side, with an inner circular one 8 ft. 4 in. in diameter. The light chamber and the frame of the light are built up of structural steel securely anchored to the concrete, and the focal plane of the light is about 51 ft. above mean low water. Considerable attention was paid to the surfacing of the concrete in the structure. The pilasters were washed and polished and in the slabs between them the aggregate was exposed, first by means of a pneumatic tool, and later with a bush hammer, and subsequently washed with muriatic acid. A 1:2:4 concrete mix was used on the work and no provision was made for waterproofing the walls at the time the concrete was placed. These were found to be pervious to the driving rains and spray of severe storms and were treated with the Edison waterproofing compound, manufactured by the New Jersey Paint Company.

The exposed location and the strong tidal currents at this point greatly increased the difficulties of construction. In this work a timber platform 30 x 40 ft. in area was built and anchored with timber piles. The material was handled in lighters moored to this dock, and the concrete plant was also on a lighter. In building the forms at each 6-ft. stage a runway was built entirely around the structure. Concrete was mixed in a Ransome mixer, loaded into wheelbarrows and hoisted to the runway in a sling on a derrick. The contractors were Chas. Meads & Company.

Concrete Floors for Shaft Stations

At the Mohawk and Wolverine mines in the copper country of Michigan, the stations at the inclined shafts have reinforced concrete floors which are absolutely fireproof and can be put in almost as cheaply as timber floors, taking into consideration the sets that would have to be used to carry such a floor, says the *Engineering & Mining Journal.*

These concrete floors are made 6 in. thick and are designed to carry a load of 400 lb. per sq. ft. The reinforcement used by W. F. Hartman, the engineer who designed the floors, consists of a double layer of 4-in. triangular mesh reinforcement, with 3/8-in. strands of old hoisting cable that have been obtained by underlaying 1 1/8-in. cable, running crossways to the strands of the triangular mesh, and at 6-in. centers.

In order to protect the reinforcement from fire and corrosion, the triangular mesh is placed about 1-in. from the bottom of the concrete.

STRUCTURAL DETAILS OF SKELETON FRAME CONSTRUCTION

By Francis W. Wilson*

IN the February issue of CEMENT AGE, under the title of "Timber Floors on a Skeleton Frame of Reinforced Concrete," the general features of this system were discussed, and the following notes cover in detail some of the structural features of this construction.

A very clear idea may be had of the appearance of this construction in its unfinished state by reference to Figs. 1, 2, and 3. Fig. 1, is a view of the skeleton frame of a building of this type, taken by means of a camera inclined at an angle of approximately 60 degrees from the horizontal, and shows the reinforced concrete beams, girders, and columns, as they appear after the forms are stripped. Fig. 2, shows a portion of one floor which has been concreted, and shows the column forms which are being erected for the next story, partly in place. Fig. 3, shows a corner of the same building, after all the forms have been stripped, and the plank floors have all been laid except on the fourth floor. At the fourth floor level, as will be seen in the illustration, the concrete beams and girders are clearly outlined, the "tees" being plainly seen, and at the time this photograph was taken no plank had been laid on this floor. The roof plank has been laid, and the outlines of the beams and girders can be faintly discerned. The floor planks have been laid on the first, second, and third floors, and in consequence these shut off the light so that the supporting concrete beams and girders cannot be seen in the illustration.

*Consulting Engineer, Boston, Mass.

FIG. 1—INTERIOR VIEW OF COMPLETED REINFORCED CONCRETE SKELETON FRAME.

This view shows the concrete T beams.

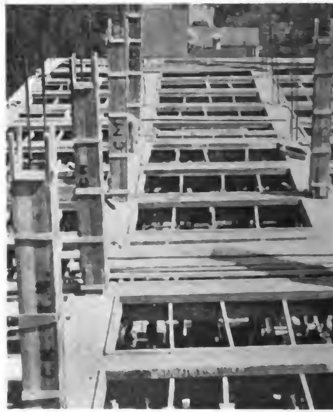


FIG. 2—SKELETON CONRETE BUILDING DURING CONSTRUCTION.

Note the spiking pieces resting on the joists. Column forms are ready for next story.

By referring to Figs. 1, and 2, it will be seen that the spiking pieces are all in place along the edges of the "tees" of beams and girders. This is the case because the spiking pieces are made use of as a part of the form work, and remain permanently in place after the concreting is completed.

In the particular case shown by the illustrations the depth, or thickness, of the tees is 4 in., and the spiking pieces are 3 in. x 6 in. in section, of hard pine. The spiking pieces are framed into rectangles, and then set on top of the joists shown in Fig. 2. These rectangles are then spaced the proper distance apart, and at intervals of from 2 ft. to 2 ft. 6 in. along the length of each beam and girder, bolts are put through a gas pipe sleeve placed between the rectangles, and then screwed tight. The rectangles formed by the spiking pieces are thus held rigidly in place, and when the concreting is completed the gas pipe sleeves afford a means of removing any spiking piece desired. The bolts used are generally ⅜-in. in diameter, and the gas pipe sleeves are ½-in. in diameter. The bolts and gas

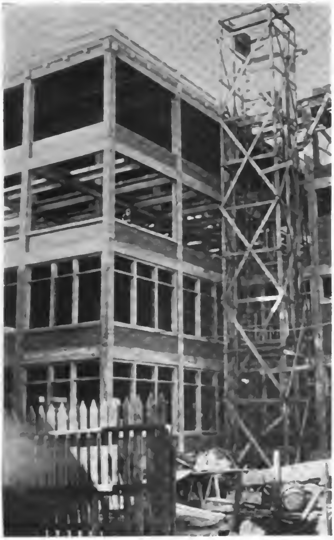


FIG. 3—EXTERIOR VIEW OF BUILDING DURING CONSTRUCTION.

pipe are placed about the middle of the depth of the tee. In other words, for a tee 4 in. in depth, the bolts and sleeves are placed 2 in. from the top of the concrete beam or girder.

In the case of the building shown in Fig. 1 to 3, the concrete was placed, and the entire skeleton frame built up before any floor plank was laid. The work was done in the summer time during very favorable weather, and the floor plank, which had been ordered from the mills in the South had not arrived when it would have been needed during construction, and consequently the work proceeded without it. There is no doubt that this method contributed to the speedy execution of the work.

The factory for Chas. W. Dean and Company, in Natick, Mass., which is also illustrated in this article (Fig. 4), was commenced in November, and completed during the winter. On account of the snow and ice collecting on the tees of the beams and girders the contractors thought it best to lay the plank for each floor as soon as the concrete supports were completed. This naturally caused a slight delay after the supports for each floor were concreted. It served the purpose however of lessening the risk to the workmen. Other buildings of this type have been constructed according to one or the other of these methods, and as there has never, up to the present time, been any serious accident to any workman employed on the construction of a building of this type it can be conceded that there is no considerable risk to employees in constructing the concrete skeleton frame entire before laying any floors.

Contractors accustomed to carrying on concrete building work, will generally, when estimating on a building of this type of construction for the first time, add a considerable item to cover the cost of runways for distributing the concrete by barrows or trucks. This conclusion is natural, since the absence of flooring or panels of concrete slabs make it appear that something elaborate in the way of platforms or runways must be used. This condition is more imaginary than real, as it must be remembered that some runways must be provided for barrows or trucks in concreting the ordinary type of concrete floor, as it is generally not practicable to wheel concrete over intricate masses of reinforcing steel, as in the case of flat slab constructions; or over open beam boxes, or terra cotta blocks, as in some other types of floor. Therefore, it should be borne in mind that some expense for runways is incidental to almost any concrete floor construction. In the building illustrated in Fig. 1, 2 and 3, the contractors used 2,000 B. M. of second hand 2-in. plank for all the runways required in placing the concrete for the entire building. The labor of moving, hoisting, and handling the plank for runways was no greater than would have been the case with ordinary types of concrete floors, and it is not probable that any less material could have been used for that purpose.

The form work for this type of construction must clearly require less materials and labor than ordinary types of concrete construction, but in case this is not plainly evident, the reasons for the comparative economy may be summarized as follows:

FIG. 4—THE FINISHED BUILDING FOR THE DEAN CO., AT NATICK, MASS.

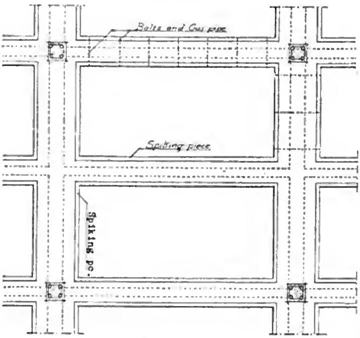


FIG. 5—FRAMING PLAN SHOWING PANELS AND ARRANGEMENT OF SPIKING PIECES.

1. The average dead weight of the floor construction during erection is limited to the dead weight of the concrete, spiking pieces, plank runways, and reinforcing steel. The dead weight of the plank and maple flooring does not have to be supported by the shoring. This means that the shoring can either be of smaller sections, or fewer posts need be used.

2. Since there is no concrete slab to be supported, the saving of materials and labor on this account is self evident. Fewer joists are required on this account, it being only necessary to provide several in each bay to hold the tee bottoms on which the spiking pieces rest.

3. This form of construction offers every opportunity for standardizing the forms, which, for the floor construction are only a series of troughs. Owing to the ease with which this can be done, it has been the custom on work so far constructed, to prepare working drawings of all the forms, and have them manufactured in a mill, and sent to the building ready for erection.

4. Only line of supports are required under each line of beams and girders, and these are stayed laterally by lines of horizontal girts, placed as such a height that they will afterward serve as supports for a staging on which the workmen can stand when removing the beam and girder forms. The column forms are stayed to the spiking pieces, and this forms an efficient wind bracing.

5. The advantage of being able to have access to the forms from *above* the floor level, instead of being obliged to work from underneath a concrete slab, will readily be recognized as conducive to easy and rapid work, both in erecting and removing forms.

6. Since each beam has only to support its own dead weight, and the live load of workmen, barrows, trucks, etc., during construction, it is possible to remove all the supports in much quicker time than could be safely attempted with solid slab construction. In summer weather the beam and girder sides can be taken off, leaving the supports in place, in three or four days after concreting, thus allowing the air to get at the green concrete and assist the process of hardening. Practically all the concrete at this stage is open to inspection. A few days later the bottoms can be removed, and one post replaced under the middle of each beam. The amount of lumber tied up in forms is therefore relatively small.

A typical floor panel, with posts spaced about 16 ft. in each direction, is shown in plan in Fig. 5. A cross section throught the forms for a beam is shown in Fig. 6. The beam sides are made of 1⅞-in. plank for the lower part, and ⅞-in. boards for the upper part. This leaves a 1-in. projection on which rest the joists. The forms are designed to go together in such a manner as to interlock with the minimum amount of nailing. Such nailing as becomes necessary is of a kind where the nails are not relied on for strength, and consequently can be driven in part way, and easily drawn out when the forms are ready to remove. The bottoms of the beam sides are held against the beam bottoms by French clamps, and are suported by the cross arm on the top of the posts. The beam sides are designed, however, so that there is a small space (¼-in. to ⅜-in.) left at the bottoms, under which small wedges are driven as shown in Fig. 6. Without the wedges the sides would be forced down by the liquid concrete against the cross arm of post, making removal difficult. When the wedges are withdrawn the bottom is freed and after releasing the French clamps removal is easy so far as the bottom edges of the beam sides are concerned. Another common difficulty which results in destroying a great amount of form lumber is at the ends of beam and girder sides are forced by the liquid concrete, hard up against the adjacent pieces of

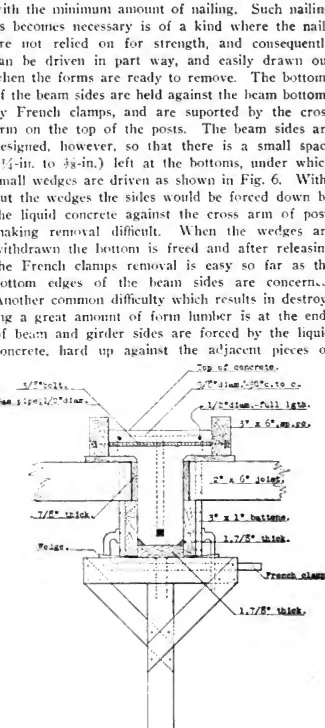
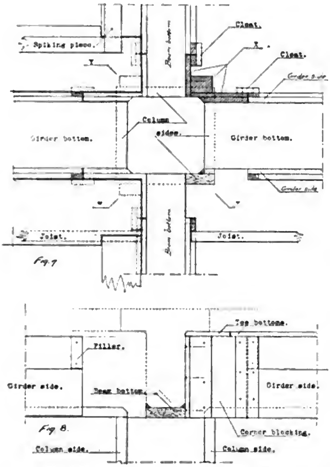


FIG. 6—DETAIL SECTION THROUGH T-GIRDER CENTERING.



FIGS. 7 and 8—CENTERING FRAMING DETAILS.

forms and removal without breaking the forms is impossible. This difficulty and loss is guarded against by the details shown in Figs. 7 and 8. The beam and girder sides do not frame into the column sides or into each other, but are made from 12 in. to 16 in. shorter than the actual length required. This leaves the ends of the beam and girder sides from 6 in. to 8 in. from the point where they would intersect, and the corner which is required is built up of small pieces, as indicated at *X*, Fig. 7. The small blocks used to construct these corners can easily be broken out when ready to remove the forms, and the ends of the beam and girder sides are then left entirely free. At *Z*, in Fig. 7, is shown a corner before the corner blocking is built in. At *X*, it is shown built, and set in place. At *W*, the "tee" bottoms have been put in place; the one running alongside of the girder, being partly supported by the joist, and partly on top of the cleats on the girder sides. At *Y*, is shown the spiking pieces placed on top of the boards which form the "tee" bottoms. It will be seen from Fig. 7, that the "tee" bottoms are notched together at their ends, so that they form a support against side thrust for the corner blocking, the beam sides, and the girder sides. In this way the forms are interlocked so that there is very little nailing required. In Fig. 8, is shown an elevation of the corner blocking on the right hand side, and at the left, is shown the end of the other girder side, placed in position, before the corner blocking has been put in place.

This arrangement serves to take care of many small inaccuracies, as it is a simple matter to remedy these in the corner blocking instead of having to alter the longer and heavier pieces. All the column forms are made of a height which come only to the bottoms of the beams and girders, as will be seen in Fig. 8, and this reduces the work of making the column forms to the simplest possible proposition, since for each story they are all of the same length, and are simply rectangles made of plank cleated together. In the details shown the beams and girders are shown of the same depth, and while this simplifies matters, yet it will not be found that there is any serious difficulty in applying the same general scheme where the depths are different. The details of the corner blocking will, of course, vary with the conditions and dimensions which have to be met, but it is a small matter to work out detailed drawings of these from which a carpenter can readily make these at the site of the work. Where the sizes of columns are changed at each floor level, this method of using corner blocking will be found especially valuable since the beam and girder sides can be used over without the necessity of any alterations,—the differences in the lengths of the concrete members being entirely taken care of in making the corner blocking.

Concrete in a Novel Public Building

Muscogee, Okla., perhaps the fastest growing city in the country, is to have one of the most practical public buildings in the United States. The building, for which bonds to the amount of $500,000 have just been voted by Muscogee county, is to be ten stories in height, and of steel and reinforced concrete construction. In addition to housing the county and city officers and courts, it will contain ground floor rooms and office suites to rent, it being figured that within twenty years the rentals will pay for the entire cost of the building.

The city and county jails will be located on the top floor of the building, insuring the prisoners plenty of fresh air, while reducing the chances of their escape.

Instead of constructing an ornate and non-revenue producing building as in the East, the people of Muscogee have decided to erect a building that will be a credit to the city, and, at the same time, impose no burden on the taxpayers.

Every change must come through education—through an effort on the part of far-sighted pioneers to show the benefits of change from customary procedure. This has been true of cement in its replacement of less economical and less efficient materials of construction. It is still true of the newer appliances for the utilization of cement and its decoration. We are still in an age of experimentation, and until methods are standardized and materials more perfectly understood, there must be this publicity or education, in order to bring with the greatest despatch the findings of investigators before those who may have use for such new methods or appliances.

FIG. 1—AN ELECTRICALLY OPERATED CEMENT MILL NEAR OBERCASSELL, GERMANY.

ELECTRIC OPERATION OF GERMAN CEMENT FACTORIES

THE Bonner "Bergwerk ünd Hüttenverein" cement mill near Obercassell, which was established in 1856 and is therefore the second oldest works of this kind in Germany, when recently extending its plant, decided upon the use of rotary kilns in connection with the wet process. This provided an excellent opportunity for adopting electrical motive power throughout the works, the more so as owing to the practically constant load, both day and night, of 10 million K W-hours, it was possible for the factory to obtain favorable supply conditions from a central station having a three-phase supply of 5200 volts at 50 cycles.

The raw material, clay and lime, is brought down the Rhine by ship and unloaded by means of three electrically operated gantry cranes, and is then transported by an electric railway to the factory. After having there been ground up in stone-crushers, the material with water added to it, passes through ball mills which grind it up to a fine "mud." Fig. 2 shows a 75 h. p. motor installed for driving a stone crusher, several mixers and a slurry-pump. The motor is operated at a pressure of 2300 volts; a switchcase and auto transformer (5000/2300 volts) are erected beside the motor.

In Fig. 3 is shown a 220 h. p. motor for driving a wet tube mill, which is connected to a 5200 volts supply and runs at a speed of 750 r. p. m. In order to reduce the speed to that of the tube-mill, which is 140 r. p. m., a large reduction gear, represented in Fig. 3 had to be used.

As regards next the wet process preparatory work, this is operated by a 290 h. p. direct-coupled motor, thus dispensing with any belt and rope transmission, which are so expensive to install and in up-keep.

The high tension switchcase mounted on the wall beside the motor contains volt and ammeters, an oil-switch with maximum and no voltage release and auxiliary contacts with series resistances. All high-tension motors in the factory are equipped with similar high-tension switchcases.

The finely ground slurry is drawn from two receptacles provided with mixers, by a number of pumps and is pumped into large tanks, in order there to be again mixed thoroughly by pneumatic

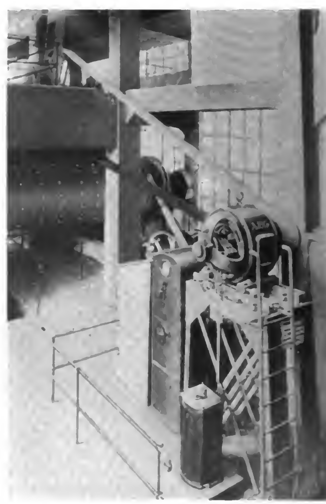


FIG. 2—MOTOR DRIVING CRUSHER, MIXERS AND SLURRY PUMP.

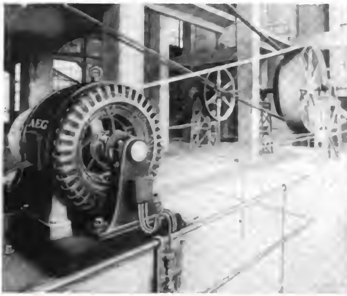


FIG. 3—MOTOR EQUIPMENT FOR TUBE MILL WITH BELT DRIVE.

FIG. 4—MOTOR DIRECT-CONNECTED WITH FORE-GRINDER.

means. It is thence conveyed to the revolving kilns by a special delivery device shown in Fig. 5. The electric drive shown in the illustration has been altered in the new plant and has been perfected from a technical point of view, inasmuch as the motor has been directly built on to the machine. In the rotary kilns visible in Fig. 6 the wet mixture is now calcined to the cinerating point. The two kilns shown are each 35 meters (115 ft.) in length and each have a diameter of 2.3 (7 ft. 7 in.) meters. The third revolving kiln erected in 1911 is 50 (164 ft.) meters long and 3.5 (11 ft. 6 in.) meters in diameter. The 100 h. p. driving motor for the

FIG. 5—MOTOR DRIVING SLURRY FEED.

two small kilns is a low-tension machine working at a pressure of 220 volts. The new revolving kiln is driven by a 50 h. p. motor with short-circuited rotor.

These motors with short-circuited rotors have been employed in several cases in the recent extension of the factory. In fact, in cement mills, where the formation of cement dust cannot be entirely avoided, notwithstanding the wet preparatory process, motors of the short-circuited type are most suitable because they suffer least when working in a dusty atmosphere, and are particularly recommended for use in places where the motor cannot be separated by partitions from the machine driven.

The pulverized coal required for the revolving kilns is obtained by grinding the coal in roll-mills, as illustrated in Figs. 7 and 8. Those of the older form shown in Fig. 7 are jointly driven by a 100 h. p. motor. In Fig 8 a standard horizontal motor drives a spur-gearing from which the vertical roll-mills are driven by half-crossed belts. More recently vertical motors have been employed for driving the mills. The form of construction and the very much more advantageous belt-transmission can be seen from Fig. 8. Each of these motors produces 30 h. p., when running at 750 r. p. m. They are low-tension motors and work most satisfactorily. The coal dust is blown into the rotary kilns by a fan directly coupled to a 30 h. p. motor.

Transport channels and elevators convey the cement obtained in the revolving kilns to the cement mills. Each of these mills requires an output of approximately 125 h. p. These cement mills are ball-tube mills. Old form motors are high-tension motors working at a pressure of 5200 volts. In order to economize space and to avoid power losses and wear on the belt, directly coupled motors are used here also. These motors each have an output of 190 h. p. at a speed of 144 r. p. m. The

motor room is separated by a wall from the mill room.

In the older form of construction (Fig 9) the belts and pulleys are enclosed in order to prevent the cement dust from penetrating into the motor room. The new arrangement allows this separation to be effected much more simply, as in the latter case only the shaft has to be protected. This is a further advantage obtained by the use of directly coupled motors.

The dust which is formed in cement mills, in spite of the dust removing arrangements provided, cannot be entirely excluded from the motor room with the older form of enclosure As this hygroscopic cement dust is a source of danger to the high-tension motors, an appreciably higher factor of safety is obtained with the new arrangement.

The large dimensions of the direct-coupled low-speed motors also offer advantages when removing the cement dust from them, which must not be underrated.

A portable compressor is employed for cleaning the motor; this works at a pressure of 85 lb. per sq. ½-in.

A 5 h. p. motor mounted on the ironwork of the ceiling serves as driving motor for the large repair workshops.

A standard-gauge single-phase locomotive has been provided to effect the shunting of railway trucks on the extensive sidings of the works.

All the different motors shown in the accompanying figures have slipping rotors. In the most recent extension of the factory however, as already mentioned in connection with the revolving kiln motors, several motors with short-circuited rotors having outputs up to 50 h. p. have been employed, which start up by means of starting transformers. This type of motor behaves well in service and can strongly be recommended for cement factories, particularly when the rotor is constructed with riveted bar-windings.

The complete electric plant of the factory at the present time comprises motors having a total output of approximately 3000 h. p., of which 12 motors—giving outputs from 50 to 290 h. p. and having a total output of about 2000 h. p.—are high-tension motors. The remainder all work at a pressure of 220 volts.

The energy obtained is distributed from a switchgear station which is illustrated in Fig. 11. In the center the low-tension switchboard may be seen from which the cables branch off to the low-tension motors. From this switchcase on the right and the left, the cables go out to the various high-tension motors. The station switchcases, in opposition to the switchcases mounted beside the motors

FIG. 6—ROTARY KILNS EQUIPPED WITH MOTOR DRIVE.

themselves, are only fitted with oil-switches and maximum and minimum cut-outs.

When electric driving was first introduced into the cement factory, only low-tension motors were employed. Of late years, however, high-tension motors have also been adopted and have given complete satisfaction. In particular, since resistances have been placed in all motor switchcases, which are connected up in series before switching in the stator winding, no breakdown has ever occurred. Switchcases are employed everywhere, in order to protect the sensitive high-tension apparatus as far as possible against cement dust. Moreover, they have proved excellent whenever the position of motors had to be altered a number of times. This is why switchcases are also made use of in the switch-gear plant, the more so as they allow uniform material to be employed as far as possible throughout the entire installation, thus requiring very little spare material.

The complete erected plant of this cement factory constitutes one of the most extensive electric equipments in German cement factories at the present day. The plant has given very satisfactory results and requires so little attention that up to the year 1909, in which year it amounted to approximately 2,000 h. p., no electrician was employed in the factory, while at the present time only one electric fitter is required for looking after the large number of motors. It is obvious that only with an electric service is it possible to work with such a small special staff.

If steam engines with an extensive transmission, etc., were employed in place of electric motors, a

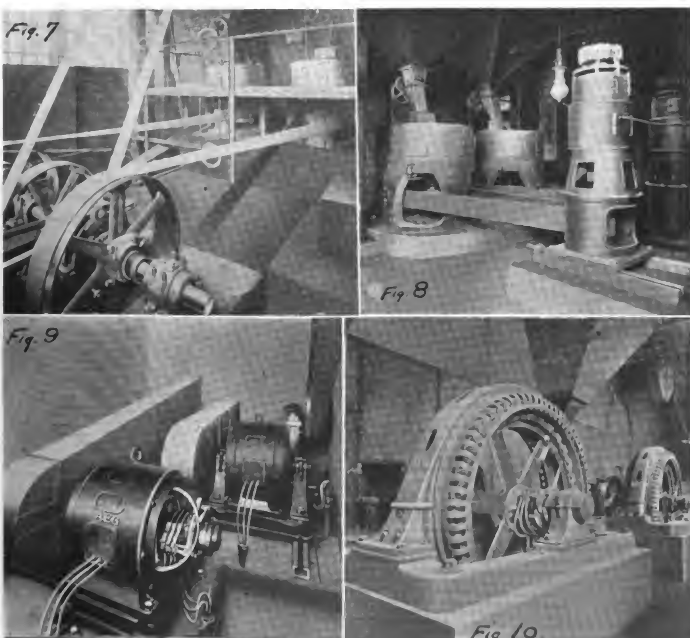


FIG. 7—SHOWS COAL GRINDERS BELT-CONNECTED WITH MOTORS, WHILE FIG. 8 SHOWS THE MORE MODERN EQUIPMENT. FIG. 9 BELT DRIVE FOR BALL MILLS. FIG. 10 THE RECENTLY INSTALLED DIRECT-CONNECTED MOTOR DRIVE.

FIG. 11—DISTRIBUTING STATION MAN ELECTRICALLY EQUIPPED CEMENT MILL.

very much larger staff would be required and on this account alone the working expenses would be appreciably higher.

The introduction of electric power, in conjunction with the revolving kilns recently adopted, has enabled the cement factory with a small staff to manufacture several times the quantity of material produced before the installation of the new plant.

CULVERTS*

Many metal pipe culverts have been built along the trunk line roads. This material for culverts is comparatively new; its lifetime is unknown; the quality of the metal is an extremely important factor and one not readily determined. While these metal pipes have some advantages, are easily and cheaply placed in position, are undoubtedly preferable to wooden plank culverts, and are also having an enormous sale, still the fact remains that *good concrete culverts are considered more reliable and should be built in preference to all other types where practicable to build them, and they will undoubtedly prove the most economical in the long run.*†

Attention is called especially to the condition of the numerous wooden culverts and bridges on the State road leading from Glen, on the East Side trunk line, westerly to Crawford Notch. These culverts and bridges are subjected to a large traffic through the summer season and practically every one of them is unsafe.

It seems that it would be a better policy to rebuild and replace these wooden death traps with reinforced concrete structures once for all time than to wait until some horrible accident has happened, resulting in the loss of life and claims for heavy damages, which may amount to as much or more than the cost of the concrete culverts, and then have to build such culverts after all these things have happened.

It is well understood that to rebuild the bridges and culverts needed in New Hampshire will require a considerable amount of money, but the State can not afford to adopt the expensive, short-termed policy of building wooden culverts and bridges.

The seriousness of these facts and the need for early action are earnestly urged.

*From "New Hampshire Highways," by Chas. H. Hoyt, C.E., Super. of Construction, U. S. Office of Public Roads; Bulletin No. 42 of the Office of Public Roads.

†The italics are ours.—Editors.

Seventeen Acres of Concrete

The California *Architect and Engineer* states that great interest is shown in the reclamation work that has just been completed in the Lisbon district in Yolo County, State of California, where a reinforced concrete levee has been built along the entire south side of the district to remove the possibility of that levee being beaten down by the waves when the tule basin is full. It is claimed this is the only concrete levee for reclamation purposes in the United States.

Lisbon district, numbered 307, has no trouble in keeping up its river levee or its west levee, but the south levee, less than half as long, built 6 or 7 ft. above the highest known high water, was beaten down six or eight times, flooding the district, which embraces about 6,000 acres of rich river land. When Engineer P. N. Ashley first proposed concrete levees and mentioned the cost the directors of the district were opposed, but they finally joined in his opinion that no other form of construction would stand the washing of the great waves that roll over the Yolo Basin in times of storm.

The cost of the 2½ miles of south levee has been $80,000 for the concrete facing, and the work has, it is estimated, made the lands in the district worth from $400 to $500 per acre. Ten thousand tons of crushed rock from the Natomas Consolidated mines were used in the work, and this and other materials were hauled to Freeport by rail and dumped on a barge to be transferred across the river, then deposited on trains of small cars by a dredger, the cars conveying them along the top of the levee to the concrete mixing plants, two of which were operated.

The levee for its entire distance across the south end of the district is faced with a strip of concrete to a vertical height of 23 ft. and 9 in., but on the slant it varies from 46 to 74 ft. in width. The area of concrete is 17 acres. The concrete is 4 in. thick, with wire reinforcements both ways and with tongue and groove piling at the bottom and a key of concrete 8 in. deep the whole length of the levee that helps to keep the great slab from sliding. Wooden strips are set in at intervals to allow for expansion during hot weather. The concrete extends 6 ft. above high water mark and the earthen levee goes on up several feet higher.

The district will now proceed to make its entire river levee 8 ft. higher than high water.

MECHANICAL HAULAGE

The Use of Steam Tractors

By Robert L. Niles, Jr.*

THE success of mechanical haulage is largely dependent upon the condition of roads. A hundred years ago, the railroad was introduced, making possible the competition of the locomotive with the horse. To-day the "good roads" of this country enable the motor truck to enter successfully the field of mechanical haulage. The prospective purchaser of mechanical equipment has before him the question of the choice of the motive power best adapted to his requirements. There are three types of motors: gasoline, electric, and steam.

In selecting a motor for heavy haulage, it would be natural to seek one possessing the characteristics of the horse. A load requires, and a horse gives, the hardest pull when standing still. Once the load is started, it is comparatively easy to keep it moving.

The gasoline—or more properly, internal combustion—engine depends for its power upon its speed. The storehouse of energy is the flywheel. The power decreases as the engine slows down, and becomes zero when the engine is at rest. These infirmities can be partially overcome by the use of a very low starting gear, and of a clutch, the slipping of which allows the engine to maintain its speed while the load is being moved off.

Although such an expedient serves well enough on a light delivery wagon, it is less successful in the starting of a five-ton load. In order to get a heavy motor truck under way, the driver has the choice either of stalling the engine, or of starting with a jerk which seriously strains the gearing. The gradual application of the clutch merely serves to slow down the engine until its power is gone. Save under ideal conditions, the only way to get started is to speed up the engine and "drop in" the clutch.

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Assuming, however, that the truck has been started, by "fair means or foul," with the maximum engine speed on low gear it makes not more than two miles an hour. To attain the high speed upon which the motor truck depends in competing with the horse, the speed ratio between the engine and the rear wheels must be changed. Of necessity this is accomplished while the truck is in motion. There results the familiar rasping of the gears. Both shocks of starting and of changing gears lead to rapid depreciation of the mechanism. Depreciation is further promoted by the speed at which, with rare exception, the motor truck is driven. The high speed gasoline engine inculcates the speed mania in all who come in contact with it.

To sum up: a heavy motor truck is put to a severe strain and undergoes more or less rapid depreciation under all working conditions. First, the shock in starting; next, the jar of changing gears; and lastly, the jolting at high speed.

It is not because the advantages of the gasoline engine are not appreciated that they are omitted from this discussion. Only when the capacity of the truck exceeds three or four tons are they overbalanced by the disadvantages mentioned. This is evidenced by the fact that several of the most successful builders of motor trucks in this country limit their machines to three tons' capacity.

The second motive power, electricity, is admirably adapted to haulage. The electric motor possesses all of the desired characteristics: simplicity, reliability, and efficiency. It develops an increasing pull as it slows down, and a maximum pull when standing still. Experience has shown, however, that being limited to a storage battery for its supply of energy, the electric power plant is not practicable at present in trucks of more than five tons' capacity.

FIG. 1—TYPE OF TRACTOR IN CURRENT USE ABROAD.

Under some conditions motor trucks are an expensive luxury. The dealer in cement, sand, or broken stone cannot afford to pay several thousand dollars for the sake of replacing three or four teams. If however, at this expense he could replace ten or a dozen teams, he might be more ready to consider the investment. The measure of the effectiveness of a team or a motor truck is neither its capacity nor its speed, but the combination of the two: the number of tons hauled one mile in an hour.

The average team hauls two tons at about two and a half miles an hour, or does five ton-miles per per hour. Taking into consideration the longer delays in loading and unloading, a mechanical outfit, to replace ten teams, would have to accomplish at least sixty ton-miles per hour. Hence a five-ton motor truck, fully loaded, would have to average twelve miles per hour—an excessive speed.

The solution lies not in *increased speeds,* but in *increased loads.* It has already been pointed out that, for continuous heavy service, year in and year out, it would be wise to limit the gasoline truck to three tons, and the electric to five.

TYPICAL COST OF HAULAGE WITH HORSES, MOTOR TRUCKS, AND TRACTORS.

DAILY PERFORMANCE.	2 Horse Team.	Motor Trucks 3 Ton.	Motor Trucks 5 Ton.	Tractor with Trailers.
Average haul (miles)	2	2	2	2
Average speed, loaded, (miles per hour) ..	2	8	6	4
Average speed empty	3	10	7	5
Running time for round trip (min.)	96	27	37	55
Idle time for round trip (min.)	24	13	18	20
Total time for round trip (min.)	120	40	55	75
Round trips per 10 hour day	5	15	11	8
Average load per trip (tons)	2	3	5	12
Total quantity delivered per day (tons)	10	45	55	96
Total work done per day (ton-miles) ...	20	90	110	192
Total cost per day ..	$6.00	$13.30	$14.75	$23.30
Cost of haulage, per ton-mile, cts.	30	14.8	13.4	12.1

The steam engine is the oldest, simplest, and most reliable of all motors. It gives an increasing pull as it slows down, and a maximum pull when standing still. Behind the piston there is always the enormous reserve energy of the boiler full of water.

Thirty years ago English engineers found that steam tractors could be depended upon to handle heavy loads over all kinds of roads. From 1899 to 1902 the supplies for the army in South Africa were transported with success over the roughest country by steam machines. The steam tractor can be started, stopped, and reversed with the greatest ease and without "changing gears." Although various sets of driving gears are used, they are never shifted when the machine is in motion.

The maximum engine speed of 250 revolutions per minute gives, through the three sets of gears, road speeds of two, four, and six miles per hour. An average speed of five miles per hour is slow for a motor truck, but since the tractor can handle with ease two six-ton trailers, the sixty ton-miles per hour—the work of ten teams—can be readily accomplished.

The low speed renders unnecessary expensive rubber tires. The driving wheels are fitted with broad, steel cleats, designed in accordance with the English regulations to do the least injury to the road surface. Teams and motor trucks are to some extent road destroyers; the tractor, doing the work of ten teams, acts in every way as a road roller.

An evident advantage in the use of tractors is that the driver and the expensive power plant need not be kept idle during loading and unloading. In the case of motor trucks, time lost in this way represents a large percentage of the day's work. At comparatively small expense the tractor can be supplied with several sets of trailers, some being loaded, or unloaded while the others are on the road.

A motor truck should never be loaded in excess of its rated capacity. On the other hand, the paying load which a tractor can handle is limited only by the conditions of the roads and the steepness of the hills. The capacity of a mechanical outfit on any given haul can be determined by reference to the work a team can do. Standard loads are as follows:

Team	2 tons
Gasoline truck	3 tons
Electric truck	3 tons
Steam tractor	12 tons

Under road and grade conditions which permit a team to handle four tons, a six-ton gasoline or electric truck will operate successfully, while the tractor will handle readily twenty-four tons, i. e. four trailers. Since such conditions are usually found in city work, where as many as four trailers cannot be hauled conveniently, *this field belongs to the heavy motor truck.*

The mechanical outfit which, in the writer's opinion, will prove most successful in each class of haulage is indicated in the following table:

Quantity of Material to be handled:	Small		Large	
Length of Haul:	Short	Long	Short	Long
Good Roads and Easy Grades	Electric, 3 ton	Gas, 3 ton	Electric, 5 ton	Gas, 6 ton or Steam Tractor
Rough Roads and Heavy Grades	Electric, 3 ton	Gas, 3 ton	Steam Tractor	Steam Tractor

Although the steam tractor is used for heavy haulage throughout England and her Colonies, as well as in the principal countries of Europe, it has

never been introduced in the United States. Until recently, mechanical haulage in this country has been restricted to the railways. Good roads have been practically unknown.

Coincident with the widespread improvement of the highways, the gasoline and the electric motor truck have been developed. It is natural that the attention of capitalists, manufacturers, and purchasers should be monopolized by these "up-to-date" machines.

When the first burst of enthusiasm has spent itself, and the limitations of motor trucks have been learned by experience, conservative engineers who wish to show permanent savings in their transportation costs will turn to the "old reliable" steam engine.

Corrosion of Iron Imbedded in Concrete

This is the title of a pamphlet by Guy F. Shaffer, presenting, in convenient form reprints and other data on this important subject. The text is accompanied by illustrations and tables of various tests. The author states that the work undertaken by him was a study of conditions under which iron might decay more rapidly than under atmospheric exposure, and if the results warranted further investigation, to put them before men of an investigative turn of mind for further study and research along well-defined lines, in order that conditions of study might be comparative and the results of value to engineering science.

After going into detail of the tests Mr. Shaffer presents the following conclusions:

(*a*) Concrete cannot be considered an insulator of steel against electrolytic corrosion. If the mass of concrete were dry it might protect the steel from electrolytic action; but concrete in the soil will probably retain more moisture than the soil surrounding it and conduct a current whenever the ground currents are active.

(*b*) Iron under stress does not seem to go into solution as rapidly as unstressed iron; but there seems to be no absolutely neutral point, and with the decrease in area due to corrosion, the stress increases, the rate of corrosion seems to increase, and thus the danger of failure is increased.

(*c*) The paints used today for structural work imbedded in concrete do not fulfil the conditions of proper protection from electrolytic action, and it is doubtful whether they are of use for protection in any sense after a lapse of some months. These tests are not conclusive evidence of that fact, but give a method for determining the loss of the film when imbedded.

A compilation of results to one case embracing all the points included in the tests would show:

(*a*) That imbedding the iron will decrease the rate of corrosion.

(*b*) That the presence of the iron oxide will decrease and localize the corrosion.

(*c*) That the stress to which the member is submitted will decrease the rate of corrosion within certain limits.

(*d*) That most of the paint-films, if intact, may have sufficient dielectic strength to resist any but the highest voltage stray currents. The test herein reported was a twenty-four hour test, and even the film which showed the highest average loss of 65% had a minimum puncturing voltage-point after immersion of 820 volts; but this is not a measure of the value of a paint-film after years of service, and some tests to determine this value are needed.

A full report of the method of testing the materials used is given in the treatise submitted to the Massachusetts Institute of Technology.

Cement Lining for Steel Pipes on the Catskill Aqueduct, New York City Water Supply

At the recent meeting of the New England Water Works Association, Alfred D. Flinn, M. Am. Soc. C. E., Department Engineer, Board of Water Supply, New York City, read a paper entitled "Protection of Steel Pipes in Catskill Aqueduct," describing the lining of some 33,000 ft. of steel pipe with cement.

Steel having been selected as the metal for the pipe plates, attention was directed to the best method of protecting it. Reports of experience from many places and special examinations of many steel pipe lines of varying ages gave convincing proofs that none of the pipe coatings commonly used was possessed of qualities giving it more than a few years' useful life. One or two cases of use of Portland cement mortar on a small scale in pipes and wide experience in reinforced-concrete construction of the protective action of the cement on the steel pointed to a method for coating the pipes. After some study it was decided to jacket the steel siphons of the aqueduct outside with rich concrete mixed about one part of cement to three parts sand and six parts broken stone or gravel, with a minimum thickness of 6 ins., and to line them with Portland cement mortar, 2 ins. thick at the minimum.

For lining the pipes, two distinctly different methods have been adopted by the two contractors; on Contract 62 grouting with forms has been employed, and on Contract 68 mortar has been applied by means of the "cement gun."* In this particular work grouting proved to be more economical and the "gun" has been discontinued.

It is hoped that these pipes will last a hundred years; they may last much longer, barring accidents. Some abuse or unappreciated condition may lead to earlier partial failure, necessitating reconstruction. The gain in smoothness of interior by covering the rivet heads and the plate laps has been computed to so increase the hydraulic capacity that three pipes equal four without lining. The total cost for the siphons with three lined and jacketed pipes is estimated as about the same as for four pipes constructed and coated in the more usual way. Obvious incidental advantages are secured by the more permanent construction.

Not so many years ago, concrete as a material of construction was looked upon with some suspicion. Its general adoption for many uses was somewhat delayed because of these misgivings, but they have now practically disappeared and concrete is constantly growing in favor, especially in highway bridge work.

*Described in "Cement Age," April, 1911.

DIPPER TRIPS FOR STEAM SHOVELS

APPROXIMATELY 23,000,000 tons of raw material are handled to produce the 77,000,000 barrels of Portland cement, and the biggest part of this is handled by mechanical diggers, principally steam shovels. The work at Panama has offered an opportunity for careful investigation to determine the comparative efficiency of dipper trips, and the *Canal Record* recently published the following description of the development of trips operated by steam:

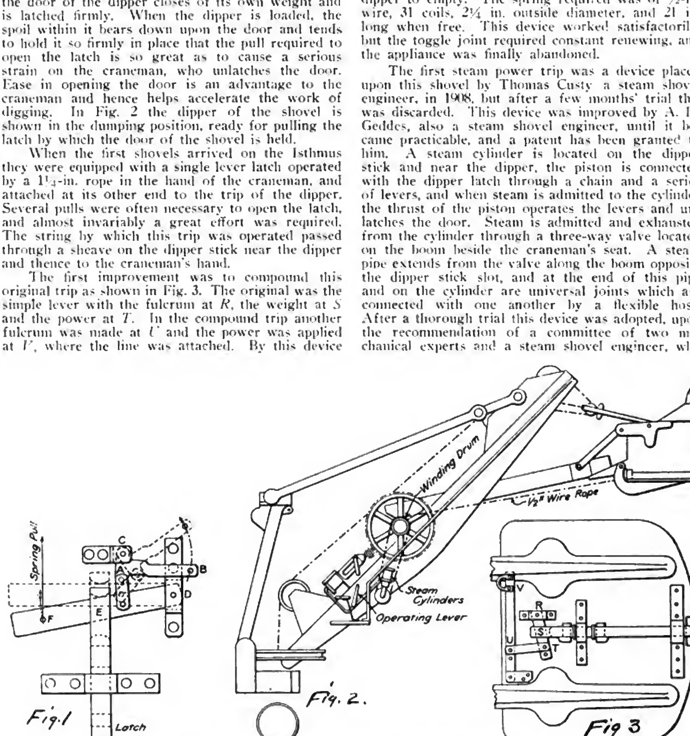
When the shovel is ready to dig, the dipper is near the ground with its center back of a vertical line through the center of the shipper shaft, as the shaft of the large gear is called. In this position the door of the dipper closes of its own weight and is latched firmly. When the dipper is loaded, the spoil within it bears down upon the door and tends to hold it so firmly in place that the pull required to open the latch is so great as to cause a serious strain on the craneman, who unlatches the door. Ease in opening the door is an advantage to the craneman and hence helps accelerate the work of digging. In Fig. 2 the dipper of the shovel is shown in the dumping position, ready for pulling the latch by which the door of the shovel is held.

When the first shovels arrived on the Isthmus they were equipped with a single lever latch operated by a 1¼-in. rope in the hand of the craneman, and attached at its other end to the trip of the dipper. Several pulls were often necessary to open the latch, and almost invariably a great effort was required. The string by which this trip was operated passed through a sheave on the dipper stick near the dipper and thence to the craneman's hand.

The first improvement was to compound this original trip as shown in Fig. 3. The original was the simple lever with the fulcrum at *R*, the weight at *S* and the power at *T*. In the compound trip another fulcrum was made at *U* and the power was applied at *V*, where the line was attached. By this device a movement of 20 in. in the line resulted in a 1-in. movement of the latch.

Among improvements upon the compound device, one that was given a trial in 1909 was the spring trip, which consisted of the lever shown in Fig. 1, and a bar passing through a slot in the latch, with a spring attached at its outer end, the power for unlatching being supplied by the spring. The rope by which the trip is operated is attached at *B*, the fulcrums are at *C* and *D*, at *A* is a toggle joint; at *E* the weight; at *F* the power applied by the spring. The door is closed by its own weight, when in the digging position, placing a tension of 1,300 lb. upon the spring, and drawing the toggle joint erect. When the dipper is in the dumping position, the craneman pulls the rope, thereby breaking the toggle joint and allowing the spring to exert its pull upon the latch, which flies back, permitting the dipper to empty. The spring required was of ½-in. wire, 31 coils, 2¼ in. outside diameter, and 21 in. long when free. This device worked satisfactorily, but the toggle joint required constant renewing, and the appliance was finally abandoned.

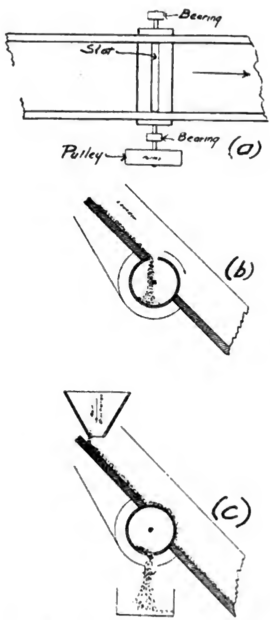
The first steam power trip was a device placed upon this shovel by Thomas Custy a steam shovel engineer, in 1908, but after a few months' trial this was discarded. This device was improved by A. H. Geddes, also a steam shovel engineer, until it became practicable, and a patent has been granted to him. A steam cylinder is located on the dipper stick and near the dipper, the piston is connected with the dipper latch through a chain and a series of levers, and when steam is admitted to the cylinder the thrust of the piston operates the levers and unlatches the door. Steam is admitted and exhausted from the cylinder through a three-way valve located on the boom beside the craneman's seat. A steam pipe extends from the valve along the boom opposite the dipper stick slot, and at the end of this pipe and on the cylinder are universal joints which are connected with one another by a flexible hose. After a thorough trial this device was adopted, upon the recommendation of a committee of two mechanical experts and a steam shovel engineer, who



FIGS. 1, 2 and 3—MECHANICAL TRIPS FOR STEAM SHOVEL DIPPERS.

reported that the capacity of a shovel was increased 100 cu. yd. a day by its use.

The latest device, that shown in Fig. 2, was invented by F. S. Wichman of the Mechanical Division. The latch is opened by a pull on a ½-in. wire rope by the outward thrust of the piston of an air brake cylinder. The mechanism is fixed upon the boom of the shovel. A drum is mounted upon the face of the thrusting gear, or shipper shaft, which revolves with the shaft, thus winding or unwinding the tripper rope, according as the dipper shaft moves up or down. In this way the rope is kept taut at all times. To give the lengthwise pull of the cable, a 6-in. diameter steam cylinder is mounted below the drum. This cylinder has a push piston, the outer end of which is bifurcated to receive a sheave, over which the cable passes on its way to the drum. Steam is admitted to the cylinder, when it is desired to trip the dipper door, through a three-way cock, operated by a lever at the craneman's seat. When the steam exhausts, a spring in the cylinder pulls the piston back into position, and the tripping operation may then be repeated.



SKETCH SHOWING OPERATION OF MECHANICAL ROTARY SAMPLER.

New or Old Lumber for Forms

Since lumber for forms costs $20 to $30 or even more per 1,000 ft. B. M., while labor on forms for building construction averages $15 to $20, it would appear to be cheaper to spend considerable extra labor on old lumber than to use new. It is a general principal in ordinary carpentry work that old lumber should always be used where possible. In form building the conditions are somewhat different because the cost of taking apart small sections may actually count up to a larger sum per 1,000 ft. B. M. than the actual cost of the new lumber, while at the same time the cost of rebuilding it is also increased.

The cost of making over old forms when the dimensions are near enough alike to avoid excessive work has been found by observation to be about 90 per cent greater than making up the same forms from new lumber.

As a general rule, new lumber is advised for patching especially where odds and ends from the saw mill are available.

It must not be understood from the above that the authors advise throwing away old stock that is in fairly good condition. On the other hand, where this old material has been used many times and is somewhat injured or in short lengths, its value is very small.

AN AUTOMATIC SAMPLER

In a recent issue of the Mexican Mining Journal, Chester Steinen, a mining engineer at Mogollon, N. M., describes the roll sampler shown in the accompanying situation. This sampler was designed for the 5,000-ton mill of the Socorro mines, Mogollon, N. M., by the superintendent, J. M. Crowdus. It is especially adapted for sampling below rolls, but may be used after any crushing machine. The construction and operation of the sampler are extremely simple; it may be made in any shop and requires no attention when in place.

In the plan, Fig. 1*a*. will be seen a cylindrical shell or pipe, having a slot lengthwise, which revolves on a shaft. The machine in position to receive its sample is shown in Fig. 1*b*. Fig. 1*c* shows the sample being discharged. The slot meets the stream of ore, receives its sample and going a little more than a semi-revolution, discharges it. With ores containing clay it cuts a clean sample. It might be used on pulp if properly packed. The amount of ore taken as a sample varies as the ratio of the width of the slot to the circumference of the cylinder.

The sampler in use here operates on a small tonnage, following two Vezin samplers. It takes a 7 per cent. cut "10" diameter and "2" slot, makes 65 R. P. M. giving a peripheral speed of 170 ft. per minute. To secure a perfect sample it is evident that the peripheral speed of the sampler must equal or exceed the speed of the ore, as the sampler when not receiving its sample acts as a conveyor. The stream of ore meets the shell at the extremity of the verticle diameter; this is important. In the sketch the bottom of the launder is shown offset below the sampler; this will prevent leakage.

Much interest has been shown in "samplers" for cement and concrete materials, and this one, from the mining field may have a suggestion of value.

SPECIFICATIONS AND COST OF CONCRETE HOUSE

In the November issue, page 204 a concrete residence was described. This was designed by William Drummond for the recent competition held by the Cement Products Exhibition Co. Following are the specifications and estimated cost for this house:

This design contemplates building all walls and piers below grade of solid concrete in forms against the earth 10 in. thick; all base or water tables, also copings, in forms floted finish, and all walls above grade of concrete blocks combined of "L" shapes and hollow shapes so as to render walls well bonded and all shapes made from machines obtainable on the market.

Sole reliance for esthetic effect to be had from design of jointing and texture of surface which is intended to be rough, the blocks being cast with fine crushed stone aggregate, without facing and colored with prepared cement paint or cement and color in water when freshly cast.

All exterior work to be colored in same way, except floors and steps. All floors and steps to be of reinforced concrete troweled to a smooth finish. Cornice and second story window sill course to be cast in molds. Cornice to be set on forming for roof slabs and held in place by casting of slabs. Sofits of eaves to be cast on closely matched board forms covered with burlap or fabric to impart texture when removed.

Chimney to be built of hollow concrete blocks providing bearing for floor and roof slabs. Reinforced beams for bearing of roof and floor slabs to be cast integral with same, to be flush at bottom with first story ceiling.

All conduits and roughing in for plumbing and heating to be cast in the slabs.

Interior to be plastered on expanded metal over metal studs and furring, the latter being secured to metal clips set in mortar joints of walls at time of laying.

All door and window jambs and external corners and corners at ceilings to be rounded to 1-in. radius in the plaster and all wood trim to be fitted to same curvature where head strips or base strips meet corners.

Plaster in all rooms to be run to floor to meet same in cove of 1-in. radius formed by pitching groove in floor to a line, lower 6 in. of work in cement finish.

All rooms to be trimmed with oak; walls to have head, base and casing strips of 3/8 x 2 in., head casing 2½ in. above doors and windows, casing 2½ in. from all plastered jambs and base 5 in. from floor returned to door jamb.

All doors, for doorways except sash doors, to have flush plastered panels built on expanded metal. Door jambs to be rabeted and set after plastering directly on to return of same. Window frames of plank set before plastering and finished with oak stops, sash of casement type glazed with plate glass set with wood stops.

All cement floors and cement base to be coated with prepared paint, rendered smooth dustless and pleasing in color.

All walls to be colored in dry color in water and glue and all trim to be treated with oil finish.

The following is an estimate of the cost of the work:

All concrete work	$2,410
Plastering	245
Tar and gravel roofing	50
Paint work and glazing	375
Mill work	540
Carpentry finishing labor	300
Hardware	80.
	$4,000

A Concrete Bridge In Ireland

Spanning a branch of the River Lee passing through the grounds of University College, Cork, a reinforced concrete bridge has lately been built from the designs of J. H. de Warenne Waller, an old student of the university, says the London *Builder*. The new bridge is 72 ft. long over all, 68 ft. between abutments, and provides for a roadway 16 ft. wide.

The work is interesting, not because of the size or importance of the undertaking, but rather for the reason that its construction presented a problem commonly encountered in practice—the construction of a bridge at moderate cost and of pleasing appearance.

REINFORCED CONCRETE BRIDGE AT CORK, IRELAND.

The question of economy is answered by the statement of Prof. C. W. L. Alexander to the effect that tenders had shown the cost of a steel bridge to be much greater than one of reinforced concrete, and to this there was to be added the cost of painting—probably $40 a year.

The aesthetic question is best answered by the view reproduced from the *Builder*, where it will be seen that the bridge is of the girder type, with panelled sides and simple but effective latticed parapets. An arch would certainly have been more effective, but was impracticable owing to the low level of the ground at either side and the necessity for allowing ample clearance for the flow of water under the bridge.

Three Million Yards of Concrete at Panama

Over 3,000,000 cu. yds. of concrete have been laid in the construction of the three sets of locks for the canal. This is approximately three-quarters of the concrete required for this work, which is estimated at 4,199,490 cu. yds.

REINFORCED CONCRETE JETTIES IN ENGLAND

IN the final report of the British Royal Commission on Coast Erosion, attention is directed to the importance of designing coast protection works so as to make sure of the attainment of the desired object, and to avoid injury to adjoining stretches of the coast line.

Many of the jetties or groynes constructed in past years have notably failed in these essential respects. High structures of concrete or timber merely collect beach material on one side and encourage the formation of deep hollows on the other, thus doing nothing in the way of building up a natural and uniformly distributed beach for protection of the shore. Moreover, groynes of this type especially if carried out beyond low water mark, have the manifest disadvantage of cutting off the flow of littoral drift from places beyond, and thereby deprive the latter of material needed for beach maintenance and improvement.

The long, low, adjustable groynes introduced by the late Edward Case, first at Dymchurch and afterwards at many places along the south and east coasts of England, represented a notable advance in groyne design, and have been remarkably successful in checking erosion in situations where high groynes had proved of no avail.

The only drawback to the Case system as originally applied was the natural and inevitable decay of the timber used as the material of construction. Within recent years this objection has been entirely overcome by the adaptation of Hennebique ferro-concrete to groyne design by Messrs. Owens and Case, of Westminster.

FIG. 1—DROPPING A SLAB IN PLACE BETWEEN GROOVED COLUMNS.

The new type of groyne is of exceedingly simple character, consisting (1) of grooved ferro-concrete columns fixed in holes excavated in hard soil or rock, or grooved ferro-concrete piles driven into soft soil or sand, and (2) of ferro-concrete slabs dropped into place between the columns. The columns are made of height sufficient to allow additional slabs to be added as the beach accumulates, and where necessary raking struts are applied to insure stability. When the beach has been built up to the required height the groynes are completed by slabs rounded at the top so as to form a smooth coping along the entire structure.

FIG. 2—THE VIEW ABOVE SHOWS THE JETTY PARTLY BUILT UP: BELOW IS THE FINISHED STRUCTURE.

This ingenious and highly-successful method of groyning has long passed the experimental stage, and at the present time eighteen of the groynes have been constructed between Brighton and Rottingdean, spaced 500 ft. apart and extending from the base of the cliff to low water mark, a distance of about 548 ft.

The first cost of ferro-concrete for the purpose compares favorably with that of timber, and bearing in mind the immunity secured from decay and the attack of sea worms, the ultimate cost will evidently represent great economy, while the assurance of permanent efficiency is a consideration of even greater importance.—*Ferro-Concrete.*

Cactus Whitewash Used in Uruguay

Consul Frederic W. Goding writes from Montevideo that when traveling through the rural districts of Uruguay, one's attention is attracted to the fine white color of the farm buildings, even during the wet season. To obtain this neat effect a whitewash is used which is made with the sliced leaves of the common cactus, macerated in water for 24 hours, producing a solution of creamy consistence; to this lime is added and well mixed. When applied to any surface, be it of wood, brick, iron, or other material, a beautiful pearly white appearance is produced which will endure through storms and frosts for many years.

In sections of the United States where the cactus is a nuisance the plant might be utilized in the manner suggested.—*Daily Consular Reports.*

AN AMERICAN ENGINEER ADDRESSES BRITISH CONCRETE INSTITUTE

AT the recent meeting of the British Concrete Institute held in London, the chief subject of interest was an address on fire-resisting construction by Richard L. Humphrey, of Philadelphia, President of the National Association of Cement Users and former expert in charge of the United States Structural Materials Laboratories, U. S. Geological Survey. The address aroused great interest in British engineering circles especially concerned in concrete and fire-resisting construction, and a hearty vote of thanks was accorded the speaker.

In his opening remarks Mr. Humphrey stated that it was rather an interesting proposition for an American to come to Europe and talk on the subject of fireproofing. The conditions in America were notoriously bad. America had the proud distinction of having the greatest fire losses in the world. The losses in America were enormous, and each succeeding year did not seem to bring an appreciable decrease in them. It would seem, therefore, rather incongrous for America to come and talk on the subject of fireproofing to a country that was particularly low in fire losses.

The very fact that they had such enormous losses in America had led them to study the subject of fireproofing and fire prevention, and it had been a necessity to find out ways and means to prevent the enormous annual destruction of building materials by fire.

In Europe, where the losses were low, the question was not by any means so urgent, and perhaps the same attention was not given to it as in America. Nevertheless his observation of the conditions in America and Europe led unquestionably to the conclusion that it behooved not only England, but all the countries of Europe, to study this question of fireproofing, and to study it seriously. In Europe there was a growing tendency to the concentration of enormous stacks of merchandise in buildings, and this was as much a menace in Europe as perhaps it was in America.

In England they were blessed with an abundance of slate and building stone. In America they had an abundant supply of lumber, and the early settlers built frame structures; then structures of a permanent form began to be erected. These permanent buildings, however, were surrounded by the inflammable structures, which in time of conflagration served as a means for burning the more permanent structures; and throughout America there were numerous illustrations of small towns wiped out in the matter of a day, or perhaps a few hours, by reason of these frame structures.

The question of the construction of buildings was always a question of economy. Fortunately in America the increasing scarcity of lumber and the increasing cheapness of concrete had led in a large measure to the elimination of these flimsy buildings, so in time probably the menace that they had in so many of their cities would be eliminated.

No building was absolutely fireproof. In America the term "fireproof building" was used, but it was a dangerous appellation to put on a building. In the first place, it instilled in the minds of the occupants a sense of security that often led them to neglect those precautions which were so necessary and which, if the building were labeled "non-fireproof," they would be careful to observe. In America, under the rather poor building laws that were promulgated generally, they erected buildings of a low fire resistance, and equipped their fire departments with magnificent fire-fighting appliances, high-pressure water systems, and the country was subjected to a great annual tax for the maintenance of this expensive fire-fighting system.

It frequently happened that the walls of a structure were standing after a fire, and people pointed to those walls as an evidence of the fact that the building had satisfactorily passed the conflagration. Sometimes the walls were of concrete, and after the fire were in good shape, and only required a renewal of the floors, doors, windows and roof, to make a habitable dwelling. People looked at that building with its walls of concrete and said, "Why, it is a first-class fireproof material." The value of the structure that remained was about 8 per cent of the cost of the building; the other 92 per cent had been destroyed. It was not the fault of the concrete. The doors were all wood, the roof was of wood, the windows and doors were all wood, so that was far from being a fireproof building.

It was a striking matter of fact that architects and people in general in America regard burnt clay as an admirable fire-proofing material. He thought in a large measure this opinion had been based on the fact that small pieces of burnt fire clay, when placed in a fire and got hot and thrown into water, are not disintegrated. But the clay was not used in that way, but in the shape of a tile. In the process of manufacture it often happened that these tiles were cracked in the corners, and when a column which was fireproofed was subjected to the action of heat, the unequal expansion of the outer face of the tile, as contrasted with the inner face against the steel, caused an expansion which the thin web at the corner was unable to resist, and the tile and the web cracked. As a result, the tile was broken away from the column, and the column, left to the action of the heat, collapsed.

He would show an illustration of this form of fireproofing with clay which he had previously described, where the space between columns has been protected by a thin veneer of perhaps two or three inches of terra cotta. They could see where the column had settled eight or ten inches by buckling, and the floor above of concrete has been so seriously cracked as to endanger its safety.

Now, it frequently happened that where terra cotta tiles had been used the lower web, by reason of its expansion, had flaked off. In a case of that kind nothing could be done in the way of restoration except by entire reconstruction of the floor.

A large number of exceedingly interesting slides showed how in many instances stone supports had lost all their structural force at an early period of a fire, and granite was even worse; moreover, as some other photographs showed, stone used in a decorative manner, though it might retain its place in a fire, was so thoroughly ruined in appearance that it might as well have fallen, for there was no alternative but remove it and build afresh. Mr. Humphrey, however, made one important statement in regard to stone—that from his observation it depended very much on how stone was quarried whether it would withstand the action of fire for a greater or less time.

An interesting incident was mentioned where a builder, in putting up hollow cast-iron columns in a building, had filled in the interior with concrete; on a fire taking place the iron columns cracked off, but the concrete core supported the superstructure.

It behooved the members of concrete organizations not to stand on the superior excellence of

concrete as a fireproofing material, but to study the question of its fire-resisting properties and the methods of its construction, so that they could intelligently design structures in which the material was applied to the very best advantage, because if conflagrations occurred in buildings that were not properly constructed, and they were destroyed, it reacted against the merit of the material; and it behooved the members interested in this industry to study this problem, and advance its intelligent use. It was not wise to say that concrete was fire-resisting and needed no protection. The structural members of a concrete building needed just as much protection as steel. He believed that, as years went round, there would be no reason why there should be even a loss of 33 per cent per capita in the buildings of Europe.

In America they were erecting buildings of concrete, not from philanthropy, but because the buildings were in themselves economical. In the first place they could construct buildings of reinforced concrete in many cases more cheaply than they could be built of slow-burning wood. In the second place, the Insurance Companies placed a lower rate of insurance on such a building than they did on the other; and, in the third place, the maintenance of that building was considerably less than in the case of wood or steel, so that the owner of such a building was not actuated by philanthropy, or to help the cause, but was governed by dollar and cent propositions, and that was why so many buildings were being erected with reinforced concrete today, and it was a blessing to the country that such was the condition.

One of the dangers of fire, Mr. Humphrey continued, both in England and America, lay often in the contents of warehouses, in the concentration of a great quantity of inflammable material, and in many cases the material contained in a building constituted the greater part of its value. In such cases concrete construction was likely to play an important part in the future for fire-resisting buildings. This in fact was thought so much of in America that in a large proportion of cases in which the building was of concrete, the owners did not think it worth while to insure the building at all, but only insured its contents, considering that these might be burned but the building left practically intact.

Mr. Sachs, in proposing a well-merited vote of thanks to the lecturer, agreed with him that terra-cotta could not be depended on except as a merely temporary protection; concrete was the best protection of structural parts against fire damage.

Another Practical Fire Test of a Reinforced Concrete Building

A fire occurred in Philadelphia, on February 3, in the new reinforced concrete building of the Blabon Oil Cloth Works. Flames raged for hours, destroying several thousand dollars worth of cork linoleum. The special matter of interest is that the building withstood the test in the same manner that every other building of like construction has done under stress of fire. It was practically unharmed, only requiring cleaning and minor repairs to broken glass before being re-occupied. So well did the structure, which is four stories in height without floors, withstand the heat of the flames which raged from top to bottom for several hours that S. Loog, manager of the plant, declared after the fire had been extinguished and he had made an inspection that no claim would be made on the insurance company for damage to the building.

Even the wireglass skylights on the top were found to be intact following the fire, and Mr. Loog declared that the debris could be shoveled out by a force of workmen and the building immediately put in service again.

The structure is fitted with numerous horizontal iron bars, from which is hung the drying linoleum. It is known as building No. 27 of the plant, and ten minutes after the fire had started the flames were raging from top to bottom, unobstructed by floors. A total of 91 pieces of the linoleum was hanging in the building at the time, and all of these were consumed by the blaze. Only a coating of ashes on the ground floor and the blackened walls inside show that a fire occurred.

An Error In Proportioning Concrete

C. Crete, of Cleveland, writing to *Engineering News*, states that there is a common error made in the proportioning of concrete mixtures, to which attention should be called. It lies in considering the sum of the aggregate proportions to be the vital point of the mixture and in disregarding the respective proportions of fine and coarse aggregate. A case in point has recently come to the attention of the writer.

The specifications in this case called for a mixture of 1 part cement, 3 parts sand and 5 parts broken stone. The contractor furnished instead a natural mixture of sand and gravel, and after an examination of the material, the engineer-in-charge ordered the use of a mixture of 1 part cement and 5 parts of the natural sand and gravel, on the ground that "the interstices contained the other 3 parts sand" (?).

From experiment it has since been found that 1 cu. ft. of the naturel mixture, measured in a box 1 ft. cubed, contained 0.45 sand and 0.75 cu. ft. gravel when the two materials were separated. It may thus be seen that to conform to the specifications, the contractor should have used $8 \div 1.2 = 6.66$ cu. ft. of the mixture to 1 cu. ft. of cement, with the following result:

6.66 cu. ft. $\times$ 0.45 = 3.0 cu. ft. sand.
6.66 cu. ft. $\times$ 0.75 = 5.0 cu. ft. gravel.

8.0

Suppose for example, that the mixture had contained 0.3 cu. ft. sand and 0.9 cu. ft. gravel to each cubic foot, then

$6.66 \times 0.30 = 2$ cu. ft. sand.
$6.66 \times 0.90 = 6$ cu. ft. gravel.

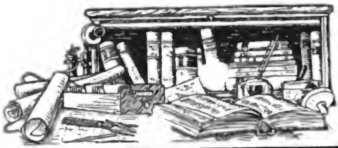
8 cu. ft.

In other words the proportions used would have been 1:2:6 instead of the 1:3:5 specified.

Removing Forms

Form lumber should be ordered by definite schedule made up from the design of forms.

The weather conditions, says *Building Age*, greatly affect the hardening of the concrete, the setting and hardening being greatly accelerated by heat and retarded by cold. If, through accident, the concrete should be frozen it will not begin to harden until it has thawed and then it may require several months to attain the strength usually reached in two or three weeks.



CONSULTATION

218. Solid or Open Spandrel Arch Construction

"In considering alternate bridge designs submitted, we are interested in further information on the comparative value of solid or open spandrel construction."

DISCUSSION BY DANIEL B. LUTEN*

For arch spans of less than 100 ft. a more dignified structure can usually be designed by the use of solid spandrel construction; for spans in excess of 100 ft., the advantage is usually in favor of open spandrel construction. This conforms also to the best practice in this country from the standpoint of efficiency. The solid spandrel construction greatly increases the loading of the bridge, but this is more than offset by the increased cost of building the structure of columns and girders of open spandrels. For short spans, solid spandrel construction is economical; for long spans, open spandrel construction is economical. For the average practice in this country, I would place the dividing line at spans of about 100 ft.

In foreign countries where labor is much cheaper, especially on form construction, and where materials are comparatively more expensive than in this country, it would undoubtedly be economical to use open spandrel construction for much shorter spans than in this country. And so the practice abroad might more reasonably be to make the dividing line at spans of from 50 ft. to 75 ft.

Where a bridge is of long span across a deep ravine not requiring great waterway, the open spandrel construction is highly suitable. But where, as in this country, many of the concrete bridges are of short flat spans requiring great waterway, there is a decided advantage in earth filled spandrels which enable the designer to approximate the curve of the arch to an elipse with maximum waterway. It very rarely occurs that the openings through the spandrels could be taken advantage of for waterway, because of the danger of becoming obstructed with drift.

234. Cost of Concrete Cornice

"I have been looking for some data on the cost of concrete cornices on large buildings. Any information on this will be appreciated."

*National Bridge Co., Indianapolis, Ind.

DISCUSSION BY R. B. DANDT*

The cost of concrete cornices depends a great deal on the type of cornice desired, accessibility, height of building and whether it is of concrete construction. In general on a concrete building, a concrete cornice is more economical than stone, but more expensive than brick and galvanized iron.

239. The Storage of Explosives

"What is the comparative value of concrete and other masonry structures for use in construction where explosives are handled and stored?"

DISCUSSION

The following notes are from a report by Maj. Cooper-Key, in charge of the Bureau of Explosives for the English Government. The report covered the explosion of a store at a Swadlincote colliery, and the part relating to comparative structural materials was recently published in *Concrete* and *Constructional Engineering* (London).

It may be mentioned in passing that in the field experience of a member of CEMENT AGE staff, a plant was built for making explosives, and the design used small one-storied unit buildings, to some extent isolated. Reinforced concrete was used throughout. The point of most interest here was that in these small unit buildings, the walls were massive concrete, many times the thickness required for ordinary stability. The roofs, also of reinforced concrete, were comparatively light. The idea in this was that an accidental explosion in any one building would spend its force upward, causing the least possible damage to surrounding structures. Every detail of the design worked toward directing the force of any explosion upward.

Following is the English report by Major Cooper-Key:

In regard to the question of the best material for the construction of a magazine or store, the principles we advocate in respect of the construction of "danger buildings" is fairly well known—viz., that in *working* buildings, where the danger arises inside, the lightest possible material is the best, but that in *storage* buildings, where danger is more likely to arise from the outside, a substantial construction is preferable. Thus no fault can be found with the method adopted in respect of this store, but the result of the explosion shows only too plainly that although the stout construction may be, and probably is, an excellent preventive of accidents, yet if an accident does occur this same stout construction adds considerably to its effects. The store did not contain more than half the quantity of explosive that might lawfully be kept in it, yet heavy masses of brickwork were hurled far beyond the distance (100 yards) which a store of this division is required to maintain from public highways and dwelling houses.

In a lecture delivered by the late Oscar Gutt-

*Chief Engineer, The A. Bentley & Sons Co., Toledo, O.

mann at a meeting of the Society of Chemical Industry on June 1, 1908, it was stated that experiments had been carried out at Cummersdorf, Germany, with a view to ascertain the effect of an explosion in a magazine constructed of concrete with an aggregate of fine gravel. Two such magazines were built and it was found that the explosion of one and a half tons of gelatine dynamite in one of these buildings failed to project any of the building material to a greater distance than 50 metres (164 ft.), and Mr. Guttmann suggests that if expanded metal or wire mesh were inserted in the concrete not only would the above result be attained but a building so constructed would also be lightning proof provided the metal in the walls were thoroughly well earthed. Without unreservedly accepting these views, inasmuch as the shattering effect of a large quantity of dynamite may produce a very different result to that which might follow the explosion of a propulsive explosive such as gunpowder, I cannot but think that there is, even on theoretical grounds, a strong probability that a material such as concrete which is not cut up into small units by lines of least resistance, as is the case with brickwork, would in all circumstances give more satisfactory results. It must not be forgotten that a lawfully situated store is surrounded by a zone free from "protected works," and it is better, therefore, from the point of view of the safety of the public, that large blocks should be projected to distances within that zone, and that only an occasional fragment large enough to do harm should be thrown beyond it rather than that quantities of bricks should be evenly distributed, as in the present case, to distances equal to nearly double the radius of the statutory "danger" zone. I would suggest, therefore, that where practicable and in places where the margin of unoccupied ground does not extend beyond the minimum distance required by law, stores should preferably be built of fine gravel concrete with an arched roof of the same material, the construction to be as light as possible with due regard to security—a condition which can be furthered by the use of expanded metal or wire mesh in the concrete.

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242. Bank Vault Construction and Resistance of Concrete to Explosive Attack

"I would like very much to get some information, as to the possibility of saturating concrete with nitro glycerine or other high explosive, and blowing it up.

"I have installed two bank vaults of reinforced concrete and am considering the installation of another. The question has been raised as to whether a burglar could saturate the concrete with nitroglycerine and in that way easily blow a hole in the vault."

Discussion by R. A. Plumb*

The possibility of destroying a bank vault constructed of concrete by saturating the concrete with nitro glycerine, is one which, due to the absence of any practical or tangible information, must be more or less of a general assumption as interpreted by the natural properties and characteristics of concrete and its general behavior.

Nitro-glycerine is a rather viscous product and we would not anticipate that it would be particularly penetrative in its nature so as to be absorbed very deeply into a concrete surface of average density.

The concrete used in the construction of the bank vault would undoubtedly be made from especially selected material and placed with unusual care, so as to produce the greatest possible strength and density, all contributing to the minimum porosity. It is questionable in the writer's mind whether in the interval that is usually allowed for the burglarizing of a vault, there would be opportunity or the patience of the operator would permit sufficient saturation of the surface to prove serious.

It would seem considerably more logical for the operator to be provided with a drill which would permit him to concentrate his charge rather than depend for results upon the material that would be normally absorbed.

It is certainly quite interesting to anticipate the actual result of the explosion of a charge imbedded in a concrete wall as compared with iron and steel. With materials of the latter class, of course the greater part of the energy of the explosion is absorbed in the distortion, bending and twisting of the metal, which would not be operative in the case of concrete, and the writer would anticipate that the result of a good sized charge of nitro glycerine in a concrete wall would be decidedly fatal to the stability of the wall, if not jeopardizing the safety of the surrounding construction, due to the violence with which the pieces of concrete would be thrown.*

In the explosion of oil tanks constructed of steel, the metal cover is usually raised and sometimes badly bent and distorted, but otherwise the results are not extremely serious. With a concrete tank, however, the explosion results in the absolute wrecking of the structure and the throwing and hurling of pieces of concrete to some distance over the surrounding territory. This particular condition, of course, would be quite naturally anticipated from the rigid nature of concrete and absence of any great degree of toughness or resiliance that would permit the absorption of shock without fracture.

It should not be necessary to confine the conclusions to anticipations in this matter, as very simple tests could be made that would enable definite conclusions to be drawn. Small cubes 6 in. in diameter constructed with a central cavity, could be filled with nitro-glycerine, and the whole block allowed to become saturated and then exploded under conditions of suitable environment and safety.

*Technical Director, Trussed Concrete Steel Co., Detroit, Mich.

*[Compare the Discussion under Item 239 above.—Consultation Editor.]

Additional Discussion of Bank Vault Construction.

In a recent number of *The Engineer* the following account was given of a test to ascertain the resistance of reinforced concrete strong rooms, and the discussion is of interest in connection with the above question.

The question of the resistance of safes and strong rooms of ordinary construction to the depredations of burglars armed with an oxy-acetylene blow-pipe and apparatus has, since the introduction of the latter, greatly exercised the attention of bank officials. It is a well-known fact that this new method of attacking steel is irresistible, even by the hardest metals. With a view to ascertaining the resistance of reinforced concrete strong-rooms—a method of construction which is now being substituted for the ordinary strong-rooms—a test was carried out recently with an oxy-acetylene blow-pipe and apparatus on a test slab designed and prepared by the Indented Bar and Concrete Engineering Company, of Queen Anne's Chambers, Westminster. The sample selected for the test was a slab reinforced with an indented bar 1/3 sq. in. side, which had previously been used in a fire-resisting test. The concrete was composed of the following: 1 part cement, 1¾ parts sand, 4¼ parts coarse aggregate (granite).

REINFORED CONCRETE MORE BURGLAR-PROOF THAN STEEL.

The oxy-acetylene blow-pipe was applied to the slab—the metal cutter being useless in the case of concrete—for twenty-four minutes, at the end of which period and after much raking out of the resulting glass formed by the fusion of the sand, and accompanied by the deafening roar of the blow-pipe, a hole 3½ in. in diameter was made through the slab. Whenever a steel bar was met the metal cutter—i. e., a stream of pure oxygen directed onto the white-hot steel—was brought into action, and the steel instantly fused away. The concrete was the material which gave the trouble, the metal cutter being powerless to act upon it.

It is interesting to note that the same thickness of steel of any grade, harveyised, nickel, nickel-chrome, or any other hardened steel, would probably have been cut through neatly and cleanly by the metal cutter in about four minutes. Apparently there is no steel made which cannot be quickly cut through in this fashion, as the process is a chemical combination of the steel with the oxygen, resulting in the complete combustion of the steel. The only form of plate which offers any resistance is a combination of steel with copper or cast-iron in separate sections; but even this, we are informed, does not present much difficulty to the oxy-acetylene flame.

The result of the test was as follows: Thickness of slab, 6 in.; cu. ft. of oxygen consumed, 55; cu. ft. of acetylene, 45; time occupied, twenty-four minutes; size of resulting hole, 3½ in. diameter. The test is clearly strongly in favor of the concrete as contrasted with steel, as the time for making a hole serviceable to a burglar is practically prohibitive, to say nothing of the roar of the burner. The really enterprising burglar must clearly seek for other means of destroying concrete.

211. Strength of Washed Materials

"The layout of our concrete plant requires the use of washed sand and gravel without waiting for it to dry, so that there is no preliminary dry mix. The material is so wet that no further water is added at all. Can you secure thorough mixing of this, and will the concrete be affected by it?"

231. Waterproofing a Porch Floor

"I have been told that the only way to make a large concrete floor watertight, is to put in the bottom reinforced slab with expansion joints; cover this with regular waterproofing of tar felt and coal tar pitch, then put on two or three inches of cinders as a bed and cover this with Portland cement finish, preferably with metal lath in it and with expansion joints in the top finish. This sounds satisfactory. Do you know any objection to it? Would not considerable water accumulate on top of the waterproofing which should be drained off?"

236. Effect of Sea Water on Concrete

"What is the consensus of present-day opinion on the above question? Is there a good text available which sums up to present date the data, theory and experiment on the effect of sea water on concrete? All the references are more or less scattered, and we would like some definite expression of opinion."

240. Heat Developing Cement

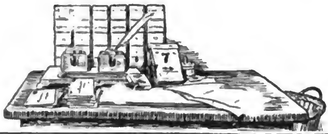
"I went through, with interest, your article on 'Cold Weather Concrete' in the January issue, and note the definite statement that concrete, in setting, develops quite a little heat.

"Can cement be made which would develop enough heat in setting to prevent freezing?"

241. Negative Salvage

"We have something like $12,000 worth of concrete foundations, being in dimensions of separate blocks on the average of 15 × 8 × 7 ft. These foundations are located under a large building and were formerly used for engine beds. They are solid concrete and were constructed some 20 years ago. Consequently they are very hard.

"We cannot use dynamite in the building and, therefore, want to find some way of rotting them out through a chemical process if this is possible. Of course, we can take them out with a hydraulic hammer, but this is quite expensive. We would very much like to get some information on this subject."



CORRESPONDENCE

The Quantity Surveyor

We wish to heartily endorse the suggestion in your columns of the introduction of "Quantity Surveying" after the English method. Only those who have worked in both countries can realize to the full the immense disadvantage of present methods of bidding on construction work. The maintenance of an estimating staff is a very heavy item in the over-head expenses of every contractor, and it is an item which the building owner finally has to pay, although it is difficult to make him realize this.

We have just sent in an estimate on a large reinforced concrete building costing about $200,000. Five other contractors did the same. In this office the services of one man for two weeks and another man for one week were spent entirely on this estimate, including a good deal of night work. The calculations covered twenty sheets closely written on both sides. Eighty requests for bids were sent out to sub-contractors. An equal amount of work was undoubtedly done by the other competing firms, only one of whom could secure the job. Comment is needless!

Plans are often incomplete or indefinite at the time bids are called for and the bidder is always in doubt as to whether he has taken off the quantities correctly and whether he has clearly understood the requirements of the specifications. To cover himself he frequently has to add an item for contingencies or to increase his estimated quantities to guard against errors. With a well drawn set of plans, careful specifications, and ample time allowed in which to put in a figure, it is our experience that jobs are very frequently let for cost or less than cost to a bidder who has left out some item which should be included in the contract. With plans that do not show clearly the requirements of a job or with indefinite specifications, absence of detail drawings, or too short a time in which to bid, we find that buildings are generally let for more than their actual cost plus a reasonable profit.

The members of the English Master Builder's Association refuse to tender in competition on jobs costing $5,000 or more unless quantities are supplied for them to bid on.

The advantages from the builder's point of view of the supply of quantities by an independent surveyor are: First, the saving of time and expense in putting in a bid, for he can make up a bid in one or two days instead of spending as many weeks on the work. Second, he is certain that he will not lose owing to some mistake in the calculation of the quantities.

The advantages to the architect would be that in a thorough examination of the plans by an independent quantity surveyor many small errors can be detected and adjusted before bids are asked for. Second, if he requires the successful bidder to deposit on signing the contract a priced copy of the schedule of quantities he has a definite basis for adjustment of variation and extra work (which are often a source of friction and trouble to all parties).

The advantages to the owner would be that bids would probably be closer. Also he would have the satisfaction of knowing that the lowest bid was probably a fair estimate of the cost of the work and that he would not be underpaying or overpaying the contractor owing to errors of the contractor in making up his estimate. Third, owing to the lower establishment charges a builder would be willing to work for less profit than at present. Fourth, that there would be no trouble in settling for payment of extra work or deductions for omitted work. At present the owner generally considers that he is being plundered on any item of extra payment, while the contractor has great difficulty in getting a fair amount paid him.

Before any system of quantity surveying can be adopted in any branch of the building trades there must be an agreement upon the way in which quantities should be measured. At present every man is a law unto himself and probably no two contractors take off the whole of their work in the same way. For instance, among brick masons some measure the net cubical content of the brick walls, some do not deduct openings, some double the corners, and when they have arrived at the total cube of brickwork some multiply by twenty and others by twenty-one, twenty-two, or twenty-three to get the brick required for the job. Among concrete contractors some measure concrete to include forms, others measure forms separately, and among those who measure forms separately some measure by the board foot, some by the sq. ft. of floor area, some by the sq. ft. of forms that touch the concrete, and so on. Among painters some measure windows by the sq. yd., others allow three times the actual surface to be painted.

The National Association of Cement Users, realizing in their own particular branch the need of some standard method of taking off quantities for concrete work have appointed a committee, of which R. A. Cummings of Pittsburg, Pa., is the chairman, to draw up rules for the measurement of concrete work. The Boston Society of Civil Engineers and the Boston Master Builder's Association also have

this matter under consideration, but have not taken any definite step towards this end, and we believe that contractors generally are feeling more and more the need of eliminating the useless and wasteful expense of estimating which they are now put to, and we welcome any effort along this line and would be glad to add our influence and experience to any movement towards the establishment of quantity surveying.

LESLIE H. ALLEN.

Boston, Mass.

[Mr. Allen was engaged for about twelve years in the profession of quantity surveying in England, and should speak with some authority on the subject. No English contractor to his knowledge has any estimating staff at all. The head of the firm usually puts the prices on and a clerk works out and details the bid.

English quantity surveying probably goes into too much detail to suit contractors in this country, but the principle is without doubt a right one.—EDITORS.]

"Concrete Terrazo"

The proposition of producing finished floors by means of surface grinding machines and without the use of top finish involves difficulties to be overcome and conditions to be complied with that must be considered in weighing its advantages. To grind a structural concrete to a finished surface means that the concrete must be dense enough to be practically without voids, and must have been worked while placing so as to eliminate the minute spaces left by globules of water, just as is done to a top finish by floating with a wooden trowel float. The aggregates in the concrete must be so sized and proportioned as to give a pleasing effect when shown in the surface.

The chief physical difficulty would be that of grinding the concrete to a surface without tearing out small particles of aggregates. This would be especially true where the concrete contains hard or tough material, flakey stone or quartz sand, all of which would be easily torn from the concrete unless the concrete is thoroughly set and hardened. This would mean that two to four weeks should elapse between the laying and the rubbing of the floor.

The natural strength of the concrete not always being sufficient, in order to save time between the laying and the rubbing of the floor, I have found it an advantage, and in most cases a necessity, to treat the surface concrete with a hardening solution to obtain the great cohesion strength necessary to retain or hold a grain of aggregate by perhaps a small surface of contact while a part of the grain is being cut or ground away.

The advantages of ground surfaces in looks and durability are apparent. There would also be an advantage in being able to build a floor that could be worked upon while a building is in process of construction, and could afterwards be brought to a perfect finish regardless of the scars and dirt of construction.

I believe the method practicable only when the problems I have mentioned are considered and met, particularly regarding the hardening of the floor surface by hardening treatment, before undertaking the grinding of the floor with a rubbing machine.

GEORGE W. DE SMET.

Chicago, Ill.

The "Control Beam" for Testing Concrete

I read with interest your suggestions made in the interest of "Better Concrete" and the "Control Beam," which seems to be simple and practical. However, a beam of the dimensions suggested by Dr. Von Emperger is of a too inconvenient size for practical work. Its dimensions are such that it could not be handled, excepting by loops, and would be injured or broken if it were laid down sideways or upside down. My own preference would be for a beam about 30 in. long and 3 in. high to be tested by one central load applied at points 4 in. apart, that is, 2 in. on each side of the central line. If this beam were 2 in. wide it could be handled without danger in any position, and I believe it would be of ample size to give accurate information regarding the concrete.

To insure a compression failure this beam should be reinforced with at least 2 per cent reinforcement. For practical work then the extreme fibre construction could be figured by the straight line formula, assuming the neutral axis to be 0.4 *d* from top of beam.

JOHN E. CONZELMAN.

Chief Engineer, Unit Construction Co.,
St. Louis, Mo.

Concrete Pipe in Kansas City

Concrete pipe is in the city specifications here for sewers, on an even footing with clay pipe. It has been a hard fight and we have been at it since last May. The clay pipe people have moved heaven and earth, almost, to keep us out. We have been fortunate in having a city engineer here who is absolutely honest and when he makes up his mind that a thing is all right, he is for it. He has made trips east to investigate the merits of concrete pipe and with the other information that he has gathered, he has decided that he is safe in admitting a concrete product along side of clay pipe.

Since we have been in the specifications, the clay pipe people have cut their prices from 25 to 40 per cent under what they were before.

We are making and selling pipe every day (weather permitting) and believe that we can win out.

B. M. HOPKINS.

General Manager, Kansas City Concrete Pipe Co.,
Kansas City, Mo.

Surface Finish on Concrete Bridges

My attention has recently been called to the efforts made by some of the early builders of concrete bridges to produce satisfactory surface finish on their works, and as the particular instances referred to here may not be familiar to all engineers, I have taken the trouble to write them down for others.

It is, of course, well known that the Romans made extensive use of concrete in the body of their piers and arches, the surface being faced with tufa and travertine, their constructive methods and the details of their anchors being [illegible] visible on the part of old Ponte Rotto which still remains. The same system of construction was extensively used on public works during the latter half of the eighteenth century and the first part of the nineteenth, but it was not until 1840 that a bridge was made almost wholly of concrete, at Grisoles, in France. It was the work of the eminent French engineer M. Le Brun, who erected a span of 39 ft. 4 in. over a branch canal of the Garonne. The only place where material other than concrete was used in this bridge, was in the exposed end of the arch ring which was faced with brick, and at the four vertical abutment edges below the springs which were faced with stone. All other exposed parts including the soffit and spandrels were of concrete. Ten years after the completion of this little bridge, the building of the Grand Maitre Aqueduct in France was begun, the construction of which continued for fifteen years. The long series of arches carrying the aqueduct was made wholly of concrete, the magnitude of the undertaking being hardly excelled by any later works. The surface finish on this aqueduct, however, was not satisfactory, for when concrete arches were again used in France about 1855, on many fine bridges, some of which are masterpieces of constructive art, they were faced with stone in a method similar to that employed by the Romans. These bridges include Ponts au Diable, Austerlitz, Notre Dame, Napoleon, Invalides and Alma. Experimental treatment of arch faces was again tried in 1868 when a 75-ft. concrete span was erected near Gloucester Road Station over the Metropolitan Extension Railway, London, the arch face being lined to represent ashlar. This attempt at imitating stone was not satisfactory, and has not since been greatly favored. It was found however, that while bridges with concrete faces appeared to be aesthetic failures, they could be quickly built at small cost, and for several years following 1873 they were generally used in Ireland by Nathaniel Jackson, for spans of 18 to 45 ft., for highway crossings in the rural districts, and on private estates. It appears therefore that many of the methods recently used for producing satisfactory surface finish on concrete bridges, were tried by others more than forty years ago, before this type of construction came into any general use, and at least twenty years before the construction of the first concrete bridge in America.

H. G. Tyrrell.

Evanston, Ill.

The Strength of Flat Plates

In regard to the application of my tests* to concrete slab design, I do not think they are of much value. First, because the coefficient I found as compared with Moody's for cast-iron ($C = 0.09$ for fixed square cast-iron and $C = 0.14$ for fixed square steel plates) shows that it is dependent on the physical properties of the material.

For rectangular plates I found that C varies as $\dfrac{1}{1+k\frac{a}{b}}$ in which $\frac{a}{b}$ is the ratio of breadth to length.†

In a rectangular concrete slab, reinforced say with transverse and longitudinal rods, the stress on the tension side is confined to two directions and the law followed by C, as the ratio of breadth to length is varied, might be totally different from that for a plate where the stress is free to distribute itself in any or all directions. For instance, my formula assumes a much smaller proportion of the load carried by the transverse fibers than the assumption that the ratio of load on transverse to that on that on longitudinal fibres is $\left(b\right)$ or $\left(b\right)^3$ The two last assumptions are made in the building laws of New York and Cleveland respectively.

With expanded metal, the condition might resemble more closely that of a homogeneous plate but in any case the similarity does not seem to be sufficient to justify the use of a flat plate formula unless, if possible, empirical constants be derived from tests on full size slabs.

Tandy A. Bryson.

Troy, N. Y.

*The tests were described in Bulletin No. 2, Engineering and Science Series, by Mr. Bryson, issued under the above name by the Penselaer Polytechnic Institute, Troy, N. Y.

†The following notes explain the symbols used:

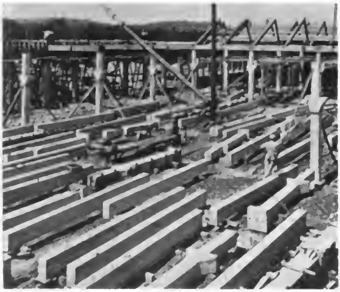
$$s = Ca^2\frac{p}{t^2} = \frac{c}{1+2.55\left(\frac{a}{b}\right)}a^2\frac{p}{t^2}$$

s = stress in lb. per sq. in.
p = normal pressure per sq. in.
t = thickness in inches.
a = short side of rectangle in inches.
b = long side of rectangle in inches.
C = coef. depending on physical properties of the material and the ratio of breadth to length.
c = 0.75 for steel plates with supported edges.
= 0.5 for steel plates with fixed edges.

SUMMARY OF CURRENT CEMENT AND CONCRETE LITERATURE

Separately Molded Members In Building Construction

Engineering Record shows the practicability and economy of the separately molded members in an article describing the new erection shop of the Heald Machine Company, manufacturer of grinding machinery, Worcester, Mass. The building is 221 x 100 ft.



PRE-CAST CONCRETE STRUCTURAL MEMBERS IN FACTORY CONSTRUCTION.

The engineers figured the cost of this building, using monolithic construction, mill construction, and steel construction, and by adopting the unit system of concrete construction with a wooden roof they were able to reduce the cost to a minimum. Details of construction are given in the article.

Grouting a Concrete Tunnel Lining

The final stage in the construction of the circular concrete-lined pressure tunnels of the Catskill aqueduct, which is being built to deliver a daily water supply of at least 500,000,000 gal. to New York City, consists in grouting such voids as may exist in back of the lining and making tight any seams in the rock through which the tunnels are driven, for when the tunnel is filled with water there would be considerable outward leakage, due to the unbalanced heads on the siphon, if all water-bearing seams were not plugged up.

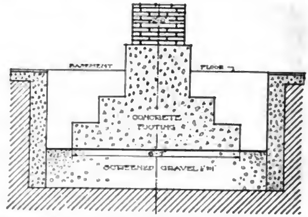
A quick setting Portland cement of Giant and Alpha brands was used. By experiment the specific gravity of the cement was determined as 3.17. A natural sand was used, 100 per cent passing a sieve having 100 openings per square inch and 50 per cent passing a sieve having 1,600 openings per square inch. Screenings and bagging sand was carried on at the shafts.

Pipes on the haunches or invert showing water were generally grouted with a 1:0 mix, for it was found difficult to force a 1:1 mix into them without immediately blocking the holes. In one case grout forced into an invert pipe traveled completely around the lining and appeared in an arch pipe.

Details and drawings of the operation are given in *Engineering Record*, December 30.

Pier Constructed for Extreme Stability

This foundation is described in *The Bricklayer* in an article on "The Design of a Physical Laboratory." It was built in the Laboratory of Physics, University of Illinois, Urbana, Ill. There are occasionally demands of stability made by physical experiments which test to the limit the standard masonry pier. To meet this exceptional but important demand three special piers were constructed. A heavy block of concrete was built on a thick bed of loose gravel. By using oil cloth over the gravel the concrete formed without becoming part of the gravel, and was thus "floated" on the gravel. The pier was then erected on this "floating" foundation. The loose gravel transmits few if any vibrations and the inertia of the heavy concrete foundation and pier is an additional protection against vibrations. A pier of this kind will stand the test of a free mercury surface.



STANDARD EXPERIMENTAL PIER FOUNDATION IN THE PHYSICS BUILDING, UNIVERSITY OF ILLINOIS.

A Reinforced Concrete Railroad Water Tank 187 Feet High

Although reinforced concrete water tanks for railway service are comparatively new and but few railroads have adopted reinforced concrete for this type of structure, the few tanks built have demonstrated the value and the wide range of design which is possible. A notable tank was recently built by the Central Ry. of Georgia at Savannah, Ga. It rises 187 ft. 3 in. from the ground line to the top of the parapet wall and 6 in. higher to the peak of the conical roof. The tank has a capacity of 150,000 gals. and consists of a chimney-like shaft 33 ft. 7 in. inside diameter at the ground line, tapering to an inside diameter of 24 ft. 7½ in. at a height of 66 ft. from the ground line, at which point the shaft assumes a cylindrical form, which is continued to the top.

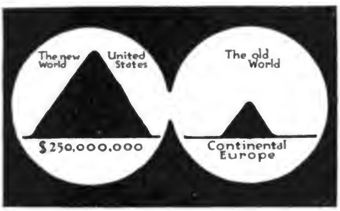
One of the features of the tank is that it is

double. There are two water storage compartments separated by dome shaped diaphragms in the shaft. These diaphragms serve as bottoms for the tanks. The upper tank has a capacity of 100,000 gals. and the lower one 50,000 gals. The upper tank is used for storage of water in case of fire on the terminals and the lower tank is for general use.

In a report on concrete water tanks for railway service presented to the American Railway Bridge and Building Association, a detailed description of the work is given by H. E. Sharpley, Assistant to the Chief Engineer. The tank was built under Mr. Sharpley's supervision.

How to Reduce Fire Losses

The answer to this inquiry, which is published on the cover page of *Insurance Engineering* for January, is that "this will continue" just as long as we defer building with reinforced concrete, the only material that has not succumbed to fire under conflagration test. With buildings of reinforced concrete, and all openings protected, there



THE ANNUAL ASH HEAPS.

is little danger of serious damage by fire. Furthermore, there should be a realization of the fact that banks, office buildings and kindred structures are, after all, merely workshops, and should be fitted up in accordance with their real purpose. To furnish them with carved mahogany, rugs and draperies may be a good advertisement from the "beauty doctor's" standpoint, but aside from the question of good taste there is always the menace of wooden trim and other combustible material such as brought about the destruction of the Equitable Building in New York City.

Danger of Lightning and Reinforced Concrete

A German paper recently claimed that the increased use of reinforced concrete in cities was largely responsible for the greater number of lightning struck buildings, since the steel imbedded in the concrete attracted the lightning. It also claimed that the result of the electric discharge was an electrolytic action within the concrete and a consequent loosening of the bond between concrete and steel. *Zement und Beton* answers this argument by saying that the contrary is true, and that reinforced concrete buildings are safer from electric discharges than any other buildings. The steel reinforcement is scattered throughout the concrete and finally communicates with the ground, thus forming an admirable lightning conductor. A dangerous bolt never strikes as a concentrated bolt but always divides into various directions. The result is that, if it enters the concrete, it is still more distributed over a large area of steel by the interlaced reinforcement and finally reaches the ground shorn of all its power. There is no question as to the setting up of electrolytic action in the concrete, for such action is only possible if a current is applied for a long time, and the bolt disappears too quickly to cause such an effect, and consequently the bond between steel and concrete with resulting weakening of the structure is out of the question.

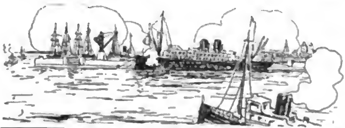
Railway Ties of Reinforced Concrete and Asbestos

A new reinforced concrete tie is being tested on the Bavarian railways, which seems to combine the elasticity of wood with the durability of steel and concrete. This tie, according to *Canadian Engineer*, uses asbestos fibres soaked in water and saturated with neat cement as one of the elements. The mixture after complete saturation with water forms a soft, tenacious mass, which does not permit tamping or ramming as concrete does, but reaches two-thirds of the breaking strength of concrete. After setting, it can be drilled, nailed, and hammered like wood and retains its hold upon other materials better than wood. The concrete consists of 1 part cement, 1 part rubble, and 2 parts gravel sand. The asbestos is used only below the actual seat of the rails. The ties are 8 ft. 9 in. long, 8 in. wide, and 6 to 7 in. thick. Seven steel rods for the tensile zone reinforcement are imbedded below the rail seat, which is also of concrete, and the asbestos is placed on top of this. This lessens the cost of the tie, as the asbestos is rather expensive. A tie costs from 6 to 7 shillings, and the weight is about three times that of the wooden tie (484 lb.) The setting of the cement and asbestos is much slower than that of concrete, and is accompanied by formation of heat. Hydrates of lime are formed in the process, as asbestos (calcium-magnesium silicate) has only a little silicic acid due to impurities. The excess of lime in the cement (25 per cent) is also changed to hydrate of lime with formation of heat. Whether the ties will meet the requirements of the expected wear and tear is still a matter of doubt, as they have only been used for some nine months so far, although they have shown no defects within that time.

Fireproofing Concrete

In the clause concerning the use of sodium silicate for enameling concrete, in the last report of the committee on treatment of concrete surfaces of the National (U. S. A.) Association of Cement Users, an interesting thought is suggested regarding the possibilities of using sodium silicate to mix with concrete in columns, girders or slabs, in order to make them impervious to any effect of excessive heat in case of fire. The passage in question is as follows: "If the concrete surface is first treated it can then be enameled. Take a piece of cured concrete thoroughly dry; immerse for a few hours in a solution of one part, 40° Baumé, of sodium silicate, three parts water; remove from solution; allow to dry in warm place for twenty-four hours. Again immerse it in the same solution of sodium silicate, remove and allow to dry in a warm place for twenty-four hours. It will be found that the concrete so treated will stand without dehydration of the cement a very much higher heat than untreated concrete."

Why would it not be feasible to mix a small percentage of sodium silicate with concrete to be used for structural purposes, so that, in the case of fire, instead of dehydration, the concrete would become enameled?—*American Architect.*



FOREIGN NOTES

Translations made especially for CEMENT AGE by F. W. Scholtz

Steel Construction vs. Reinforced Concrete Construction

The field open to reinforced construction has steadily expanded within recent years and has in many respects crowded steel construction to a second place. The steel interests have therefore started an active propaganda against reinforced concrete and the present article will review the arguments advanced by both sides. The first step was taken by the steel interests in opposing steel girder floors in comparison with reinforced concrete floors. Another point has been the relative protection against fire and corrosion. The reinforced concrete construction is ideal in this respect, but the steel girder construction can also be made as efficient by covering the girders with mesh and coating this with a concrete covering. The dependance of concrete construction on good mixing and first class aggregates and cement, as also the uncertainty of knowing whether all of a certain material is equivalent in quality to that which was tested, has been advanced against concrete. While this is true in some respects, it is just as true to some extent in steel work, for steel girders made from the same material have been known to differ greatly in strengths from those established on test pieces. The recent test methods* of Dr. Von Emperger moreover, seem to permit a constant testing of the construction concrete which is impossible in steel construction. The chance of reinforcement shifting its position in the concrete and thus decreasing the strength of the girder has been brought up. This chance is in good work slight, and it can be considered as out of the question. A slight shifting of the reinforcement would still leave a large enough factor of safety. The fact that concrete increases in strength with age should be added as a factor in its favor, a statement which cannot be made by the steel men. The accidents which occurred during construction are also cited by the opponents. In most cases they can, however, be traced back to a chain of unfortunate circumstances, to which must be added the fact that reinforced concrete is still in its infancy, while steel looks back upon more than fifty years of practice. That steel is not free of accidents was proved in the recent collapse of the new Hamburg gas holder. The last two points of contention are the comparative length of time needed for construction and the comparative cost. Concrete is rapid and economical. The fact is, that both construction systems can exist side by side and do not need to war against each other, although it is true that for some types of structures reinforced concrete is the better material, while for others the steel is better.—*Tonindustrie Zeitung.*

*See "The Control Beam for Testing Concrete," "Cement Age," November, 1911, February, 1912.

Influence of High Temperatures on Mortar and Concrete

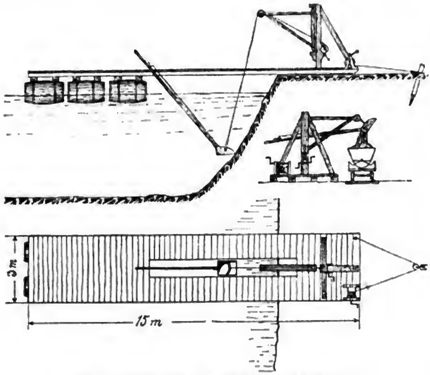
The purpose was to study the influence of gases from + 70° to + 250° C on mortar and concrete, especially in relation to chimneys. Mortar cubes were allowed to set at the ordinary temperature and at high temperatures. Those set at high temperatures (250°) showed after 26 weeks a decrease of strength equal to 32-47 per cent below those setting in the open air. Prof. Germer, who made the tests proposed the following proportions for chimneys: One litre (0.035 cu. ft. of 61.02 cu. in.) Portland cement, 1 litre slaked lime, 1 litre air-dried, fine loam, 1 litre ordinary sand. The results may be summarized as follows: 1. To obtain the greatest strengths, the mortar should not be subjected to great heat at too early a period; i. e. new chimneys should not be used too soon after completion. 2. Lean cement mortars with fine loam* sand are preferable to extended cement mortars, as they set easily when exposed to the air, and resist any sudden changes of temperature. 3. Sudden cooling of mortars which have been heated, lowers the strength by 36-40 per cent. 4. The tensile strength of mortars when setting in high temperatures drops to 60-80 per cent of the standard. 5. The bond between the mortar and the bricks is destroyed by high temperatures at setting and is practically rendered equal to zero.

Concrete.—The proportions of concrete test cubes were 1 cement, 3 gravel or 1 cement, 7 gravel. Fine gravel was used, the largest grain of pea size. The greatest difference of strength between air and high temperature set concrete shows after 14 weeks. It is 50 per cent for fat mixtures and 55 per cent for lean mixtures. If concrete is used for chimneys, it should be lined with a good insulating material, so as to protect the concrete against the high temperatures of the flue gases. Cooling concrete with water after exposing it to great heat lowers the strength by 26 per cent for fat mixtures, and 45 per cent for lean mixtures. The bonding strength (adhesive strength) between concrete and steel was found to decrease 30 per cent below normal at 150°, and 50 per cent at 250°. Sudden cooling of concrete and steel decreases the bonding strength by 50 per cent.—*Armierter Beton.*

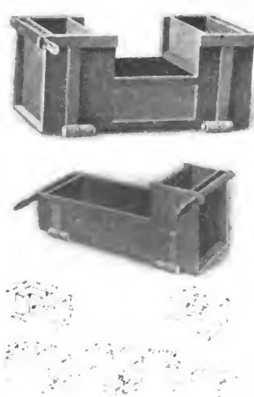
An Improved Cement Boiling Test

The disadvantage of the Michaelis cement boiling test lies in the fact that the result depends too much upon the degree of setting of the cement pat at the time of testing. Often a coarsely ground cement does not stand the test, while the same cement, ground fine, will stand it. It is also possible to make a cement stand the test by adding sodium carbonate. A cement tested after 24 hours will sometimes not stand the test, while the same cement tested after 48 hours will stand it. The improved test avoids all these possibilities in the following way. The purpose is to have the pat set more quickly. The cement pat is made in the usual manner and then left for 15-20 minutes on a gypsum slab. Then the pat is heated on a thin iron plate over an open flame till no more water evaporates. After cooling, the pat is placed 10 minutes under water, at the room temperature, then left three hours in the open aid and subjected to the boiling test.—*Tonindustrie Zeitung.*

*Loam (German=Lehm) is probably the fine sandy aggregate used by foundrymen in making loam molds, and not the organic product.



SAND DREDGE OF SMALL CAPACITY.



MOLDS FOR CONCRETE-CORK TILE AND TYPICAL SIZES.

Sand Dredge of Small Capacity

A lime sandstone plant requested the description of a cheap sand dredge to dredge out sand below water level, raising it to a height of about 15-30 ft. with a daily capacity of about 500 cu. ft.

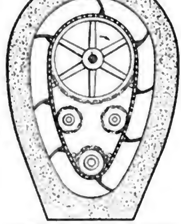
The figure shows a hand dredge for this purpose, composed of four wooden joists (8 x 8 in.) of about 45 ft. length; and 380 sq. ft. of boards; an iron scoop about 40 in. long, 28 in. wide and 24 in. deep; two wire ropes of about 30 ft. length, and a hoisting drum; the entire apparatus arranged in such a way that the scoop can be lowered and raised through the slit in the pier, shown in the lower cut. One workman holds the long handle of the scoop, while the other raises the scoop by means of the hoisting drum, filling the scoop with sand, raising it above ground, and emptying it into a hopper. The front end of the dredge rests on the sandbank, while the other end rests on the planks, which are supported by several empty oil barrels, which float on the water. A wire rope on a hoisting drum at the front end fastened to a dead-man, holds the dredge in place, and allows the same to be moved forward or backward with the progress of dredging. The scoop can be filled 15-20 times per hour, and raises about 165 cu. ft. per hour. Three men are sufficient to work the dredge.—*Tonindustrie Zeitung.*

Device for Manufacture of Non-Circular Cement and Concrete Pipes

The figure shows a recently patented device (D. R. P. 238,659) for the production of non-circular or oval cement and concrete pipes. A number of curved trowel blades are fastened to an endless chain, and these travel over a larger and smaller chain wheel. These two chain wheels determine the front and rear form of the pipe, and the lateral sides are determined by adjustable wheels.—*Tonindustrie Zeitung.*

Hollow Cork-Concrete Tile

German concrete constructors have recently tried the combination of concrete tile and cork in buildings and have met with great success. Hollow concrete tile alone does not insulate properly against moisture and atmospheric changes, and the use of concrete tile with cork insulation facing the outside of the building has eliminated this defect of the hollow tile. All of them have some form of an angle. The height of the tile is about 10 in., the weight about 60 lbs. The tiles are made at the building as needed, thus saving considerable cost of transportation. The tiles are of such form that only one mold is needed. This is of sheet iron. The cork layer is placed in the mold, and then the concrete is rammed on top in layers, obtaining a thorough bonding a concrete and cork. Then the mold is opened, and the tile is removed with its cork base, which can then be left to set. If the outside of the tile is to give the effect of any special surface, a cast steel plate showing this design is first laid in the bottom of the mold, followed by concrete, then the cork layer and finally again concrete. — *Beton und Eisen.*



DEVICE FOR MAKING NON-CIRCULAR CONCRETE PIPE.

A REINFORCED CONCRETE AIR DRYING PLANT

The blast furnaces "Deutscher Kaiser" in Bruckhausen use desiccated or dried air for their furnace blast, as such a procedure reduces the fuel consumption and gives better results. The air is drawn in by large ventilators, passed over some hygroscopic substance like calcium chloride, and then sent to the blast furnaces. The plant consists of one evaporating chamber with a sub-basement underneath, the cooling plant with ventilators, and the air chamber which conveys the desiccated air to the dryers and blast furnaces. The entire building is constructed in reinforced concrete.

The evaporating chamber *a* in Fig. 1, is constructed in plain concrete with very light horizontal and vertical steel reinforcement in the walls. The roof of this chamber is a plain roof with the steel girders bearing on the outside walls of the building. A long diagonal girder bears the load of this roof in the center, and this girder in its turn rests on three reinforced concrete columns which are placed at regular intervals throughout the width of this chamber and divide it into two equal halves. These columns are bracketed at a certain height above the floor to allow the rails for an overhead 10-ton crane to be installed later on. The floor of this chamber rests on columns in the basement. The effective load for each of these columns is 18,000 kg. (39,600 lb.), and the total load carried by the basement roof is 5,500 kg. sq. m. (1,100 lb. sq. ft.) The floor of this basement is one continuous reinforced concrete slab, which supports the bases of the columns just mentioned. The principal reinforcement of this slab is a continuous steel network at the top and bottom. The slab below the evaporating chamber is 3.3 ft. thick. and below the cooling plant it is 4 ft. thick. The pressure on the slab is 2.5 kg. sq. cm.

The cooling plant consists of three large cooling chambers, an air distributing and ventilating chamber, and a staircase on one side leading from the roof down to the basement. Except for the plain concrete wall between this room and the evaporating chamber all construction is in reinforced concrete. The walls which separate the various sections of the cooling chambers are designed for the proper loads. The outer wall was designed to allow for rather unique pressure. In computing the reinforcement, allowance was made for an outer and inner wind pressure of 150 kg. sq. m. (30 lb. sq. ft.) as also for temperature. Fig. 2 shows the construction, as also the details, of the girder reinforcement. The walls are made broader at the base, resting on the concrete slab, so as to ensure greater safety. The floors and ceilings of the cooling chamber are of plain girder and beam construction with a "Rabitz" floor suspended so as to get a plain surface, and offer as small a resistance as possible to the air in the chambers. The weight of the cooling and drying material was estimated at 2,800 and 5,600 kg. (7,160 and 14,320 lb.) on the different floors, and the space between them for an effective load of 200 kg. sq. m. (40 lb. sq. ft.). The dead weight of the slab, web, "Rabitz" floor and insulation was computed at 660 kg. sq. m. (132 lb. sq. ft.). The floors were computed as continuous girders, spanning three openings with a moving load. Fig. 2 gives the details of these floors and reinforcement.

The cooling chamber ends on one side in an iron skeleton wall resting in the basement on a reinforced concrete girder which is supported by the two outside walls and center walls of the cooling chamber, and by reinforced concrete columns between them. The reinforced concrete walls and floors of the three stories of the cooling chamber rest on angle irons and anchorages riveted into this steel wall.

The air channel or conduit was the most difficult to construct, as the floor and the walls facing the outside are exposed to the pressures of ground waters when the nearby Rhine has a high water level. The floor was constructed as an inverted reinforced concrete girder floor; the walls as steel skeleton walls, and the roof as an iron girder with concrete slabs. A network of thick steel rods was used for reinforcement, and the waterproof asphaltum insulation was placed between the outer concrete

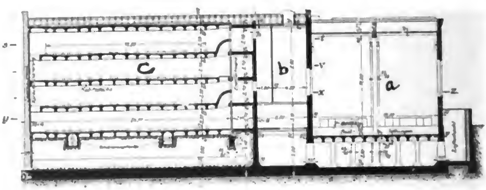


FIG. 1—LONGITUDINAL SECTION OF AIR DRYING PLANT.

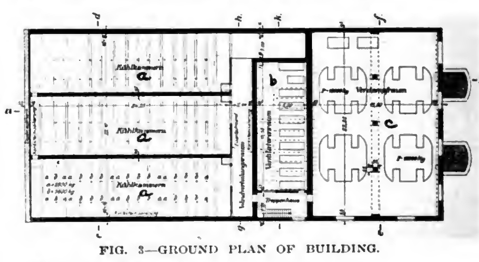


FIG. 3—GROUND PLAN OF BUILDING.

a. Cooling chambers.
b. Ventilators.
c. Evaporating chambers.
d. Air conduits.

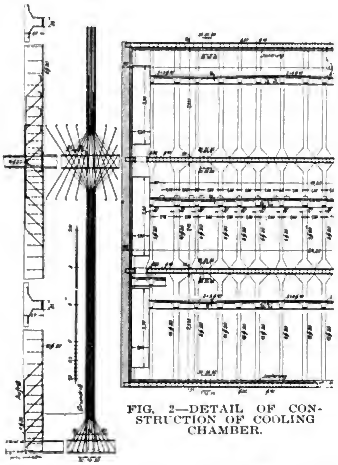


FIG. 2—DETAIL OF CONSTRUCTION OF COOLING CHAMBER.

wall and the inner concrete-covered steel network. This strong construction was necessary to sustain the external and internal pressures. All of the floors and walls in the cooling chamber are insulated by cork layers so as to retain the cold temperature and shut out the heat from the outside. Fig. 3 shows a ground plan of the entire plant with cooling chambers on the left, the air distributor and air ventilator chambers in the center, and the evaporating room on the right, with the air channel of conduits leading to the blast furnace on the extreme right, adjoining to the eavporating chamber.—*Armierter Beton.*

Competition Between Reinforced Concrete and Iron Products

German concrete and cement manufacturers have started the campaign against the attacks of the iron and steel manufacturers and their fight against concrete products. The iron men claim that concrete through its progressive work has become one of the greatest competitors and has reduced the sales of such products as iron pipe, steel girders, columns and beams and similar materials used in the construction work. They have therefore requested the German Government to raise the freight rates on all concrete products. The strangeness about this attack on concrete rates is that the reinforced concrete products are more expensive than similar iron and steel materials, and the choice of the concrete is not based on its greater cheapness but rather on some other more favorable features like less maintenance costs, fireproofness, greater utility, etc. There can therefore be no question of underbidding in price on the part of the concrete interests. The *Baumaterialien Markt* has compiled some figures showing the relative weight of iron and concrete products of the same strength, and has found that in nearly all cases the iron and steel material has the lesser weight for the same materials and is in this way in a more favorable position than the concrete industry. Moreover many concrete construction parts cannot be sent completed to their destination as is the case in the iron line, but must be sent in parts like steel reinforcement, cement, etc., whereas the steel men can send a finished girder ready for raising into position at the building, to be constructed. All things considered, the iron men face much more favorable conditions in their line than the concrete men, and an increase in rates discriminating against the concrete interests only would be unfair and poor business.—*Baumaterialien Markt.*

A New Box Type Floor

An interesting type of floor was used in a recent reinforced concrete power house constructed in Finland, called the "box" type floor. Fig. 1 shows a cross section of this floor whose members consist of 8 cm (3.2 in.) thick beams, with a space of 75 cm (30 in.) between every two beams, and a 3 cm (1.2 in.) lower and a 7-10 cm (2.8-4 in.) thick upper reinforced concrete slab, all cast at one time in the following way: the lower slab is first poured

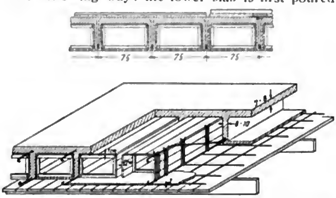


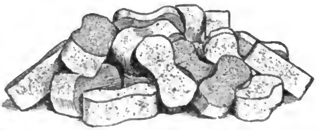
FIG. 1—CROSS SECTION AND ISOMETRIC VIEW OF CORED FLOOR.

on a flat wooden mold and wooden boxes, open at the bottom, made of 1 cm (0.4 in.) thick boards, are set upon this bottom slab. The steel rod reinforcement is then placed in the spaces between the different boxes and then the beam and upper slab are poured and molded in concrete.

The wooden boxes remain in the floors, but the cost of lumber is so slight in Finland that the loss is not felt. The floors can be made for any length span and load; are monolithic and rigid, but carry sound with great ease so that the boxes are often filled with coke and ashes to deaden sound transmission.—*Beton und Eisen.*

Earthquake-proof Concrete

"Le Béton Armé" reproduces a short letter written from a correspondent in Italy who visited Messina, the scene of the earthquake last year, and saw the results of that disaster. He and his party were wandering through the ruins and desolated buildings, when to their surprise they came upon a house which was in good condition and showed no traces of any earthquake. They thought that this building had perhaps been built since the disaster, but found out on inquiry that it was of reinforced concrete and had resisted the earthquake perfectly, not even exhibiting a single crack as a result of that experience.—*Le Béton Armé.*



BRIQUETTES

MONTHLY COMPARATIVE TABLE

Imports of Portland, Roman and Hydraulic Cements.

Country	Month of Dec., 1910 Barrels	Value	Month of Dec., 1911 Barrels	Value
United Kingdom	186	431		
Belgium	17,667	23,517		
Germany . . .	2,272	3,580	13,718	21,360
Canada	8	18	8	14
Other Countries .	1,564	2,323	3,358	5,409
	21,697	$29,869	17,084	$26,783
Less Foreign	944	1,225	151	241
	20,753	$28,644	16,933	$26,542

Decrease in imports during the month of Dec., 1911, as compared with Dec., 1910 . . . . . 3,820 barrels

Country	12 Months Ending December, 1910 Barrels	Value	12 Months Ending December, 1911 Barrels	Value
United Kingdom	26,551	$ 30,325	12,397	$15,409
Belgium	133,668	175,042	8,571	10,396
Germany . . .	101,986	148,057	127,076	203,970
Canada	6,200	9,024	1,059	2,060
Other Countries .	23,909	33,980	14,699	22,423
	292,314	$396,428	$163,803	254,258
Less Foreign	17,914	24,878	8,519	14,095
	274,400	$371,550	$155,284	240,163

Decrease in imports during 12 mos. ending Dec., 1911, over 12 mos. ending Dec., 1910 . . . 119,116 barrels

Imports of Portland Cement into the U. S. during December, 1911 by Districts

District	Barrels	Value
Boston	96	$ 190
New York . .	3,953	6,150
Philadelphia . .	165	274
Key West . .	9,578	16,184
Hawaii	3,284	3,971
Minnesota . .	8	14
	17,084	$26,783

Exports of Cement

Exports of cement, month of Dec., 1910—249,189 bbls., value $340,758

Exports of cement, month of Dec., 1911—229,848 bbls., value $330,257

Decrease in exports, month of Dec., 1911, as compared with month of December, 1910 . . 19,341 barrels

Exports of cement, 12 mos. ending Dec., 1910, 2,475,957 bbls., value $3,477,981

Exports of cement, 12 mos. ending Dec., 1911, 3,135,409 bbls., value $4,632,215

Increase in exports during 12 mos. ending Dec., 1911, over 12 mos. ending December, 1910 . 659,452 barrels

Testing Cement

At a recent meeting of the American Society of Engineering Contractors, in the address by retiring President Harris, a point of interest to all engineers who have to specify tests for cement was brought out. Mr. Harris stated that, under the present specifications, tests required for cement fail to provide the safeguards anticipated. For instance, while the usual method of taking one barrel in every ten of a shipment as a sample of the material, the method of mixing the samples is not satisfactory. It is provided that, to determine the characteristics of a shipment, the individual samples may be mixed and the average tested. This may not be objectionable where the cement is used in massive concrete subject to compression only. In reinforced concrete, however, because comparatively thin members are used, this method should not be allowed.

The reasons given by Mr. Harris for his position are as follows: It is acknowledged that 80 per cent. good cement will carry 20 per cent. poor cement. If the average sample of a shipment shows only 20 per cent poor material it is, according to standard specifications, allowable. However, the mixing which is done with the samples is, of course, not repeated with the bags of cement since it would be impracticable to take a carload shipment, mix it and remeasure it to secure the proper proportion.

The result is that where mixing up a batch of concrete, the sacks used may contain as much as 50 per cent. bad cement, and just as likely as not this concrete may be placed in a portion of the structure where only the best material should be used.

Again a shipment of cement may contain the products of different mills, cement which may be different in regard to setting time, fineness, etc. It is bad practice to use two brands of cement in the same concrete mixture, but if the products of several mills are placed in sacks of a common brand, it is impossible to tell by looking at the sack whether the contents of a car would run uniform or not, except by individual tests.

This question is of much importance to architects, engineers, contractors, and manufacturers of cement or cement products. Mr. Harris recommended concerted action by this Society with other technical societies to eliminate the foregoing defect of the present specifications.

Freight Rates on Returned Sacks

The Sack Committee of the Association of American Portland Cement Manufacturers announces that the movement on the part of the Western Classification Railroads to increase the freight rates on returned empty cement sacks and other carriers, has been defeated, and that no increase over the present rates will be made at this time.

Cement Industry in South Africa

Although the demand for cement in South Africa grows larger each year, less is imported. This is due to the fact that English capitalists have built Portland cement plants in Pretoria and other places, and produces a large quantity of the cement used in the various localities.

PENNSYLVANIA COMPANY EXPERIMENTING WITH CEMENT TIES

The *Railway World* for February contains an interesting article on experiments with concrete ties now being conducted by the Pennsylvania Railroad, which, during the year ending December 31, 1910, used 5,666,322 cross ties in renewals on its system. More than 118,000,000 cross ties were used by the various steam and electric roads in 1907, which shows how tremendous is the demand compared with the resources of the forests, a demand which led to the planting of trees by the Pennsylvania Company some years ago. Wooden ties cost from 85 cents to $1 each. Hence the urgent necessity of finding an economical and practical substitute. The forms of the tie adopted by the Pennsylvania for experimental use is clearly shown by the accompanying plan. The general dimensions of the tie follow closel·· the standard set for wooden ties where heavy traffic is to be handled. That is, the concrete tie is 8 ft. 6 in. over all, with a width, or bearing surface upon the ballast, of 8 in. and with a maximum height from the base of the tie to the highest point, which are the edges of the spaces left to receive the rails of 10¾ in. The distance from the end of the tie to the edge of the space in which the rail sets is 17¼ in. The width of the rail space is 8½ in. while the remaining distance between the inside edges is 4 ft. 2½ in.

The chief difference between the concrete tie and a regular wooden tie is, first the provision by which the rails are to be set into the tie so that only the heads of the rails protrude above its finished surface; the tapering of the tie beyond the outside edge of the rail towards the end of the tie so that its thickness is decreased from 10 in. to 4 in. and, finally, the tapering of the tie in the center, giving it a minimum thickness of 6 in. The purpose of the departure from the ordinary shape used for wooden ties is interesting. It is believed that the tapering of the end of the tie beyond the rails makes a more symmetrical roadbed, decreases to some degree the shoulder of ballast ordinarily required at this point, decreases the weight of the tie, and reduces the likelihood of having any obstruction catch in the track and derail or damage the equipment. The tie is tapered in the middle not only in order to save material, and added expense, but also weight which increases the ease of handling. In addition it will be noticed that the bottom of the tie between the centers of the rails is slightly concave, the center being an inch higher than the points immediately under the rail.

FIG. 2—CONCRETE TIES IN PLACE. Showing method of securing rail.

The Pennsylvania Co. has broken sharply away from the practices heretofore followed and has endeavored to hold the rail into the tie rather than on it. The method of accomplishing this is clearly indicated. It will be noticed that after the rails have been set into the grooves of the tie and bolted up in place, rough molds are placed around the grooves in which the rails are setting and wedged into place. The space bars, to keep the rails gauged, are still in place. When the molds have been placed the track gang makes a rich concrete mixture and pours it around the rail filling up the groove and running up to the bottom of the heel of the rail.

The cost of the Pennsylvania's form of concrete ties cannot be accurately known at this time. It is probable, however, that these ties will cost between $1.25 and $1.50 apiece, depending upon the quantity manufactured, the nearness of the supply or raw material and other variable factors.

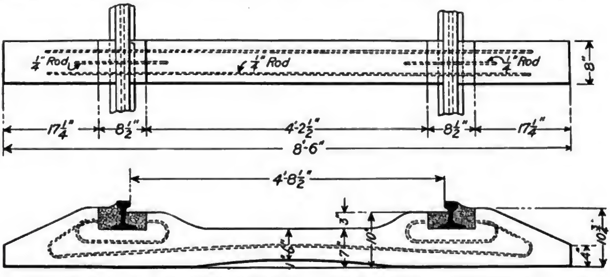


FIG. 1—DETAIL OF CONCRETE TIE WHICH IS RECEIVING EXPERIMENTAL EMPLOYMENT ON THE PENNSYLVANIA RAILROAD.

ASSOCIATIONS AND CONVENTIONS

NATIONAL ASSOCIATION OF CEMENT USERS, Harrison Building, Philadelphia, Pa., Richard L. Humphrey, Philadelphia, President.

The program of the Kansas City Convention (March 11-16), of the National Association, was published in the February issue. A most interesting and valuable meeting of concrete engineers and builders is promised.

NORTHWESTERN CEMENT PRODUCTS ASSOCIATION, 410 Pioneer Press Building, St. Paul, Minn., J. C. Van Doorn, Security Bank Building, Minneapolis, Secretary.

NEBRASKA CEMENT USERS' ASSOCIATION, York, Neb., Peter Palmer, Oakland, Neb., Secretary-Treasurer.

IOWA ASSOCIATION OF CEMENT USERS, Ira A. Williams, Ames, Ia., Secretary.

CONCRETE MACHINERY MANUFACTURERS' ASSOCIATION, Le Roy A. Kling, Secretary, Cedar Rapids, Ia.

OKLAHOMA CEMENT USERS' AND CONTRACTORS ASSOCIATION, D. C. Patterson, 330 Bassett Building, Oklahoma City, Okla., Secretary.

INTERSTATE CEMENT TILE MANUFACTURERS ASSOCIATION, Estherville, Ia., L. L. Bigham, Estherville, President; Charles E. Sims, Worthington, Minn., Secretary.

CANADIAN CEMENT AND CONCRETE ASSOCIATION, Wm. Snaith, 57 Adelaide St., Toronto, Ont., Secretary.

The Work Done by The Cement Show

The shows have a broad appeal. Their effect is equally felt by those who do not attend in person but who have suggestions made to them by those who have been able to attend. They profit at second hand by the lessons of the shows. Dealers in building supplies can make the local work of contractors more efficient if they will study conditions, make helpful, constructive criticism of methods of work, and endeavor to constitute themselves bureaus of information on construction matters.

In some small towns where there are no contractors, dealers are renting out concrete mixers at $1 per hour, and furnishing a man to operate the machine at slight extra expense.

The closer the dealer can be to the contracting operations in his town the closer he will be to profits. If he can be a real help to his contractor customers, or if he can make an actual business connection with such interests, he has eliminated a certain amount of competition and placed his sales on a surer footing. But for this he must be posted—he must not consider his duties to end with the delivery of materials, but he must make himself a master of the trades covered in such operations. He need not be a skilled mechanic, and yet the more intimate his acquaintance with actual work, the better will he be able to advise and assist. Dealers who have realized the possibilities in this line have been among the most interested visitors at the cement shows. They have taken home to less progressive workers the best of the years offerings. A special tool may make a strong appeal, or it may be a gravel washer. The shows are a mine of information to the man who attends with his eyes open.

Cement Section of the Boston Textile Show

One of the most interesting departments ever instituted in connection with a trade or industrial exposition will be the cement section of the Textile Exhibition to be held in Mechanics Building, Boston, April 22-27. It will be devoted exclusively to cement and concrete construction. Special concessions will be made for this department and already a number of firms prominent in the cement industry have taken space. Limited amount of space will be available for this portion of the Exhibition and all who are interested should write at once for particulars to the Manager, Chester I. Campbell, 5 Park Square, Boston, Mass.

International Safety Congress

The new American idea of the Safety Engineer, an accident prevention specialist, will be brought to the notice of world industrialists at an International Safety Congress to be held in Milan, Italy, for five days, beginning May 27, 1912.

The American Museum of Saftey, 29 West 39th Street, is making preparations so that the United States will be well represented. An American National Committee has been selected by the American Museum to co-operate with the International body and to promote the American ideas and views at the Congress.

Minnesota Establishes State Testing Plant

A laboratory and machinery for testing the quality of cement and gravel used in the construction of concrete culverts and bridges in Minnesota, for the benefit of local road authorities as well as itself, has been installed by the State Highway commission in the basement of the Capitol.

Materials for road surfacings, road beds, and concrete for floors of bridges as well as other uses to which it is put in this kind of work, will be tested in the laboratory, with the view of determining the best mixtures to be used under the particular circumstances and climatic conditions to be met in each piece of work. What proportions of cement and gravel for concrete work and what of gravel, clay and sand for road surfacings, will be determined through a series of tests.

For the last several years the commission has made extensive use of concrete in bridge and culvert work, and it now recommends this material as the best that can be used for these purposes and for floors of bridges. It is to aid local and county road authorities in obtaining the best of this class of material and of extending its use is such work throughout the State that the commission has offered to make tests for them as well as for itself.

The Leonard Construction Co., not Inc., McCormick Bldg., Chicago, announces that Frank N. Spencer of Toledo, Ohio, has become associated with them as manager of their eastern department.

THE FIFTH CHICAGO CEMENT SHOW

THE Chicago Coliseum, from February 21 to 28, was the scene of the fifth annual Cement Show to be held in that city. That the Show was successful goes without saying, but for this result no credit can be given to the weather man. On the opening day Chicago was visited by the worst blizzard it has experienced in 18 years and on the Monday following another very heavy snow storm tied up railroad and street traffic. Such conditions naturally had the effect of reducing the attendance, but there was no time during the Show when an interested crowd could not be found in the big building.

An experiment in the division of the floor space was tried in the shape of having all booths face on short aisles running across the building and no aisles running lengthwise, except at the sides. The consensus of opinion seemed to be that this method was a success. It tended to scatter the crowd and as there was no "main aisle" each exhibitor was on an equal footing. The railings and backgrounds of the booths were the same used at the New York show.

The character of the exhibits was perhaps more educational than in any former exhibition. This was particularly true of the displays of several of the cement companies. The Universal Portland Cement Co. occupied five sections in showing models of five different types of street pavement in which concrete is used either as a base or for both base and surfacing as well. These models were shown in cross section in glass cases so that the exact method of construction could be followed. Real earth, real concrete and even real grass at the roadside made this a very noteworthy exhibit.

The Chicago Portland Cement Co. had an equally practical exhibit consisting of a group of miniature farm buildings all cast of concrete. The house, cow-barn, hay-barn, corn-crib, pig-sty and poultry house were all reproduced in detail, even to models of the animals. In the duck pond, however, it was found impossible to use concrete ducks. Another part of this exhibit that came in for much attention was the concrete tables, chairs and benches designed for either porch or indoor use. Almost half the visitors to the show wanted to see the Edison concrete furniture and after viewing the Chicago A. A. Exhibit they were not disappointed.

The "model" of the Gatun locks at Panama shown in the Atlas Cement Co.'s booth attracted a great deal of attention as it did in the New York show. As a result of a fire in the building where this expensive model was being stored just previous to the show it was very nearly destroyed. Only heroic work by Publicity Manager Tomes and his assistants made it possible to repair the damage and have the model installed on the opening night.

Excellent displays of ornamental concrete work were made by several other cement companies.

Among the machinery exhibits were several new types of mixers, conveyors, tools, etc., which will be described from time to time in these pages as opportunity offers. A novelty for cement shows was the exhibition of the Mack dumping auto truck, especially designed for contractors and building supply dealers.

The visitors to the show seemed to be largely of the classes who were earnestly seeking for information and many exhibitors of machinery reported very gratifying sales.

Excellent music was furnished during the show by Bredfield's Chicago Concert Band. An added feature in the musical line was the singing of several solos by Miss Carolyn Thomson, of Minneapolis, Minn., who possesses a voice of rare beauty. Miss Thomson is a niece of L. V. Thayer of the Peerless Brick Machine Co., who has never missed a cement show.

Tile Manufacturers Meet

During the show the Interstate Tile Association held a three-day convention at the New Southern Hotel. Papers were read on different problems of the cement tile industry and there was a general discussion of process, materials, etc.

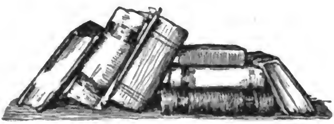
The following officers were elected for the coming year: President, P. H. Atwood, Armstrong, Iowa; Vice-President, D. G. Keith, Ceylon, Minn.; Secretary-Treasurer, Howard H. Two Good, Boone, Iowa.

Concrete Trade Press Entertained by W. A. Radford

One of the pleasantest events of the cement show week was a "Dutch Supper" at the Hotel Metropole to which the representatives of the various cement and concrete periodicals were invited by William A. Radford, President of the Radford Publishing Co. After a very excellent supper, during which music was furnished by an orchestra, there were informal talks by nearly all the 21 men present. Some of the problems of the trade publishing world were discussed and in this way a group of men all striving toward the same end were drawn closer together. A similar meeting might well become an annual event.

Pumice Stone Concrete Floors

Pumice stone-concrete floors have been used for various concrete buildings with great success. They are in form of large slabs, which are placed over the construction beams. Upon these, wire mesh reinforcement is laid which is again covered by a second concrete slab. Fire tests made with these floors proved that they were able to resist a heat 1000° C. for two hours without showing any effect.—*Baumaterialien Markt.*



NEW BOOKS

DIRECTORY OF PORTLAND CEMENT MANUFACTURERS, together with manufacturers of GYPSUM AND LIME, 1912, compiled and published by Cement Era, 1207 Morton Building, Chicago, Ill. 3 x 5 in., leather bound, 250 pages. Price $1.

REINFORCED CONCRETE BEAMS AND COLUMNS. By W. Noble Twelvetrees. Published by the Macmillan Co., 66 Fifth avenue, New York. 5 x 7½ in., cloth bound, 167 pages, illustrated. Price, $2.00 net.

THE THEORY AND PRACTICE OF TECHNICAL WRITING. By Samuel Chandler Earle. Published by the Macmillan Co., 66 Fifth avenue, New York. 5 x 7½ in., cloth bound, 301 pages, illustrated. Price, $1.25 net.

FIFTH ANNUAL REPORT of the Board of County Road Commissioners, Wayne County, Mich. From October 1, 1910 to September 30, 1911 inclusive. 6 x 9 in., paper bound, 53 pages, illustrated.

STREET LIGHTING, University of Illinois Bulletin No. 51. J. M. Bryant and H. G. Hake. 6 x 9 in., paper bound, 61 pages, illustrated.

CONCRETING IN COLD WEATHER. Universal Portland Cement Co., Chicago and Pittsburg. 6 x 9 in., paper bound, 40 pages, illustrated.

JOURNAL OF THE AMERICAN SOCIETY OF ENGINEERING CONTRACTORS, Volume III, No. 10. American Society of Engineering Contractors. 13-21 Park Row, New York City, N. Y. 6 x 9 in., paper bound, illustrated.

EARTHQUAKE-PROOF CONSTRUCTION. Trussed Concrete Steel Co., Detroit, Mich. 5½ x 7½ in., paper bound, 46 pages, illustrated.

COST KEEPING SHORT CUTS. Burroughs Adding Machine Co., Detroit, Mich. 5 x 7½ in., paper bound, 190 pages, illustrated.

TESTS ON REINFORCED CONCRETE COLUMNS. Bulletin of the University of Wisconsin, No. 466, M. O. Withey, series of 1910. 6 x 9 in., paper bound, 115 pages, illustrated.

The bulletin presents the results of tests on reinforced concrete columns made in the laboratory for testing materials of the University of Wisconsin during the years 1909 and 1910. These tests are a continuation of a branch of the work reported in *Bulletin* No. 300. The purpose of these experiments was to make a further study of the strength and elastic properties of columns reinforced with spirals and longitudinal rods. The tests were made to obtain some data relating to 1, the effect of varying the percentage of spiral reinforcement; 2, the effect of varying the percentage of longitudinal reinforcement; 3, the effect of varying the richness of the mixture; 4, the effect of a small number of repeated loadings; 5, the effect of maintaining a constant load for different time intervals; 6, the behavior of columns eccentrically loaded; 7, the relative value of plain and deformed bars for longitudinal reinforcement; 8, the effects of differences in end conditions. All told, 66 columns of commercial size were made and tested. A most valuable feature of this Bulletin is the inclusion of a complete bibleography of tests on reinforced concrete columns.

Standard Documents of the American Institute of Architects

What marks a decided advance in the preparation and manipulation by architects of building contracts is the publication of standard forms by the Institute for this work. The Standing Committee on Contracts and Specifications has been at work on these documents for five or six years, and they have passed through seven or eight editions in an effort to make them as practical as possible before issuing them for public use, as is now done. Criticisms have been obtained not only from practicing architects outside of the Committee on Contracts and Specifications, but from representative builders in various cities. The documents as now published are not designed to supplant the Uniform Agreement as heretofore published by Mr. Soltmann on behalf of the American Institute of Architects and the National Association of Builders. As the result of negotiations with Mr. Sayward, the secretary of the latter organization, however, an arrangement was arrived at which permitted the Institute to provide for the publication of these new documents without effecting the previous arrangement relating to the Uniform Agreement. The documents are published by E. J. Soltmann, 134 E. 29th street, New York.

Canadian Combine Publishes Quarterly Magazine

Following precedent in this country, the Canada Cement Co. Limited, will publish quarterly a magazine or pamphlet on the uses of cement. The first number, issued in January, relates to farm improvements. The fact that this field was chosen as the initial subject shows that cement manufacturers realize that vast quantities of cement will eventually be consumed in distinctly rural communities. The January issue of the Canadian paper is attractive typographically and thoroughly practical in text and illustrations. It shows a great many uses for cement on the farm and instructs the reader as to proper methods of mixing and placing concrete.

Insurance Engineering for 1912

The Insurance press announces the appointment of Ira Gould Hoagland as editor and manager of *Insurance Engineering*. He will assume these duties on January 1, 1912. A new typographical style, and new editorial plans, beginning with the January number, signify the progress and improvement of the magazine.

REINFORCED CONCRETE COLUMN DATA

IN Bulletin No. 466 of the University of Wisconsin, "Tests on Reinforced Concrete Columns," by M. O. Withey, the conclusion based on the test data indicate that:

1. If materials can be obtained at average unit prices, rich mixtures are more economical than lean ones. Considering materials similar to those employed herein, the more economical mixtures will be produced if the proportion of cement to aggregate, by weight, lies between 0.2 and 0.7.

2. Although the yield point of a reinforced concrete column is practically independent of the percentage of spiral reinforcement, the ultimate strength and the toughness are directly affected by it. On account of the excessive deformations accompanying loads beyond the yield point, on account of the probability that both yield point and ultimate strength are less in repeated or long time load tests than in the progressive load tests ordinarily made in the testing machine, and on account of the uncertainties which always surround the hypotheses adopted in designing, good practice demands that only a portion of the stress producing disintegration of the outside shell be used as a working stress. Consequently, only enough lateral reinforcement is needed to prevent the longitudinal rods from bulging outward, and to provide an additional factor of safety against an overload by increasing the tougness and raising the ultimate strength somewhat above the yield point. From these tests 1 per cent of a closely spaced spiral of high carbon steel seems to be sufficient for this purpose.

3. By the addition of longitudinal steel the yield point, ultimate strength, and stiffness of a spirally reinforced column can be considerably increased. If maximum economy in floor space is desired, if a column is so long or is so eccentrically loaded that tension exists on a portion of the cross-section, or if a large dead load must be sustained by the column while the concrete is green, a high percentage of longitudinal reinforcement may often be advantageously employed. Such reinforcement is also a valuable safe guard against failure due to flaws in the concrete. If the cost of cement is extremely high, it may be economical to use a leaner mixture than suggested in 1 and considerable longitudinal steel to increase the stiffness and strength. In general, however, *cement is a more economical reinforcement than steel.** Therefore, for ordinary constructions it does not seem advantageous to use in combination with a rich concrete more than 2 or 3 per cent of longitudinal steel.

4. The amount of data presented on tests of columns subjected to repeated or time loadings is far too small to warrant drawing definite conclusions as to the limiting stress for repeated loadings which will hold true for all kinds of columns and for an infinite number of repetitions, or for a prolonged loading. However, it does appear from the results presented that there is practically no increase in set or deformation after a few repetitions of loads equal to 40 to 50 per cent of the yield points of the columns tested. The results of the repeated load tests also plainly indicate that there is considerable additional strength and toughness afforded by the spiral after the yield point of the longitudinal steel has been passed.

5. The close agreement between theoretical values and values derived from test data shows that the formula commonly used in designing short homogeneous columns eccentrically loaded, may be applied to reinforced concrete columns, provided suitable allowance be made for the steel.

6. The strength of a column resting upon a footing will be about as great as when bedded on a metal plate, provided considerable lengths of the longitudinal reinforcing bars are bent outward into the slab or footing. The results given show that the use of metal base plates and longitudinal steel milled to the required length leads to greater uniformity in strength.

7. Although only a few test pieces were reinforced with deformed bars of high carbon steel, the results were so uniform and the strengths so high that attention should be called to this type of reinforcement. It is quite evident that, with certain ratios of unit prices, the use of deformed bars with high elastic limits will be more economical than the use of plain round bars of mild steel.

Briefly summarizing the foregoing, it seems economical to use for reinforced concrete columns a very rich mixture, and advantageous to employ about 1 per cent of closely spaced high carbon steel lateral reinforcement combined with 2 or 3 per cent of longitudinal reinforcement. From the test data presented it seems apparent that such columns, centrally loaded, may be subjected to a static working stress equal to one-third of the stress at yield point.

In considering the above conclusions, it must be borne in mind that the specimens were very carefully made. Great care was taken in pouring to thoroughly puddle the concrete with a rod as fast as it was poured into the columns. It was by this means that pocketing of the stone was prevented and a full cross-section obtained throughout the length of the column. Puddling is a very effective method of securing uniformity in fabrication. When it is impossible to use this method the size of the largest particles composing the aggregate must be much smaller than the pitch of the spiral and a very wet mixture must be used. Assuming as hypotheses that a well balanced design will be made, that careful inspection will be given to the selection and testing of all materials and to the details of fabrication, it seems practicable to secure similar results in actual construction.

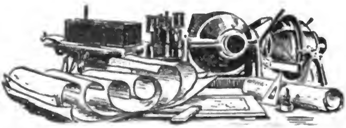
*The italics are ours.—Editors.

Farmers will Have Nothing But Concrete

Chairman Van Dorn, of the Northwestern Portland Cement Association, was interviewed during a recent visit East and made the following statement concerning the use of cement in the Northwest:

"Concrete is king among the agriculturalists of the Northwestern grain States. If the farmers of the Dakotas and Minnesota continue to utilize cement and reinforced concrete at the present rate wooden buildings will soon become a rarity.

"Up in our country the farmer is doing everything with concrete. Not only does he build his house of concrete but he insists upon the most modern concrete barns, poultry runs, granaries, fence posts, telephones poles everything, in short, that formerly was made of wood."



PATENTS

In order to keep the readers of CEMENT AGE *in touch with the progress that is being made along the lines of invention in the cement industry of the United States, a list of patents granted by this Government will be published monthly. No attempt shall be made to describe any patent in detail or to publish any diagrams in this department; patents that cover vital points will be treated in the regular editorial columns if their importance warrants. Rather it is the purpose of this list to keep the reader posted in the principal inventions that are of interest and value; detailed information will be furnished on request to* CEMENT AGE.

Illustrations and specifications of any of the patents mentioned in this department will be forwarded on receipt of 25 cts. to cover costs. Address Royal E. Burnham, 857 Bond Building, Washington, D. C.

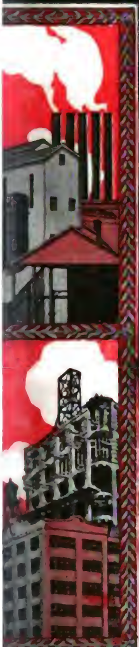
1,014,090. Rail-fastening. Alvus H. Moffet, Larned, Kans.
1,014,096. Mausoleum. Thad. H. Rowland, Oberlin, Ohio.
1,014,157. Floor and ceiling construction. Henry L. Lewen, New York, N. Y.
1,014,221. Device for making plates of artificial stone. Adalbert Hermann, Vienna, Austria-Hungary.
1,014,258. Kiln-cleaner. Lewis P. Ross, Standish, N. Y., assignor of one-half to Northern Iron Company.
1,014,360. Mold for vaults. Edwin T. Allen, Detroit, Mich.
1,014,416. Building structure. William Schweikert, Brooklyn, N. Y.
1,014,424. Method of and apparatus for forming roofing-shingles. John W. Troeger, La Grange, Ill.
1,014,526. Railway-tie. Charles Seddens, Eastwood, Ohio.
1,014,614. Temporary-burial vault. Joseph St. Clair, Philadelphia, Pa.
1,014,626. Caisson. Oliver Cromwell Edwards, Jr., Troy, N. Y.
1,014,630. Sectional mold for concrete construction. Milton D. Morrill, Washington, D. C.
1,013,870. Caisson. Oliver Cromwell Edwards, Jr., Troy, N. Y.
1,014,636. Drain-conduit or culvert. Edward Carroll, Kirksville, Mo.
1,014,656. Method of sinking, lining, and cementing shafts. Paul Albert Legrand, Brussels, Belgium.
1,014,711. Metal reinforcing and spacing bar. Alfred E. Lindau, St. Louis, Mo., assignor to Corrugated Bar Company, same place.
1,014,712. Metal reinforcing and spacing bar. Alfred E. Lindau, St. Louis, Mo., assignor to Corrugated Bar Company, same place.
1,014,721. Pneumatic caisson of ferro-concrete. Stanislaw Rechniewski, St. Petersburg, Russia.
1,014,726. Railway-tie. Warren A. Saul, Bridgeport, Conn.
1,014,735. Concrete pipe. Elliott S. Wortham, Chicago, Ill.
1,014,738. Form work for concrete construction. Robert Anderson, Cincinnati, Ohio.
1,014,990. Winding-drum. Theodore Ahlborn, Chicago, Ill., assignor to Waterloo Cement Machinery Corporation, Waterloo, Iowa.
1,015,279. Beam form and joist for concrete structures. Robert Anderson, Cincinnati, Ohio.
1,015,334. Pipe forming apparatus. George M. Myers, Toronto, Ohio.
1,015,463. Molding machine. John E. Wilcoxen, South Bend, Ind.
1,015,584. Garden edge tile. Albert Emmanuel Powell, Darwen, England.
1,015,588. Automatic tile machine. Johannes Roth, Ludwigshafen-on-the-Rhine, Germany.
1,015,687. Concrete mixer. William L. Keller, Kearney, Neb.
1,015,706. Mold. Walter Parjer and Lyman E. Campbell, Neola, Iowa.
1,015,981. Concrete mixer. Carl E. Roberts, Atchison, Kans.
1,016,140. Form or mold for concrete. John K. Goin, St. Louis, Md.
1,016,151. Cement fence post. Jacob Huber, Blakesburg, Iowa.
1,016,284. Collapsible form. Herreman O. Meek and Curtis E. Bradburn, Garden City, Kans.
1,016,285. Concrete mold. Herreman O. Meek, Garden City, Kans.
1,016,319. Spacing device for reinforcing rods in concrete structure. William H. Bure, St. Louis, Mo., assignor to Corrugated Bar Company, same place.
1,016,485. Form for concrete construction. John Elsmere, Battle Creek, Mich.
1,016,760. Reinforced concrete structure. Matthew Mingay, Detroit, Mich.
1,016,845. Cross tie. Lawrence C. Loney, Montgomery, Ala.
1,016,912. Metal concrete container. Isaac A. Braddock, Haddonfield, N. J., assignor of one-sixth to William C. Codd, Baltimore, Md., and one-sixth to Nicholas A. Kester and one-sixth to David E. Anthony, Washington, D. C.
1,016,920. Concrete mixer. Alvah D. Hadsel, Dorranceton, Pa.
1,016,957. Building construction and block therefor. William H. Ricker, Cambridge, Mass.
1,016,984. Deformed reinforcing bar for concrete. William Arthur Collins, Chicago, Ill.
1,017,026. Post mold. Franklin P. Van Hook, Caldwell, Idaho.
1,017,028. Beton or concrete sleeper with resilient rail supports. Otto Wilhelmi, Feldmeilen, Switzerland, assignor to Rudolf Wolle, Leipzig, Germany.
1,017,029. Form for tunnel work. Edward G. Williams and Elmer H. Brown, Washington, D. C.
1,017,042. Railway tie. Frank Eisel, Frank Hagen, Arthur Schroeder, Breeze, Ill.

MAY 1912

Cement Age

A MAGAZINE DEVOTED TO THE USES of CEMENT
with which is combined
Concrete Engineering

VOL. XIV APRIL, 1912 NO. 4



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CEMENT AGE

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CONCRETE ENGINEERING *Established 1907*

ROBERT W. LESLEY, Editor; ALLEN BRETT, Managing Editor; E. A. TREGO, Associate Editor; F. F. LINCOLN, Business Mgr.; R. M. BABBITT, Western Mgr.; A. B. HENRY, Circulation Mgr.

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THE APRIL ISSUE

AN ANALYTICAL TEST OF BEAM AND SLAB CONSTRUCTION presents the results of a careful study of actual constructions. A finished floor is loaded, and the deformations in steel and concrete are read by special instruments. Results in some ways are surprising. The slab acts in compression entirely across the panel. Probable tension in the concrete is indicated.

THE EIGHTH ANNUAL CONVENTION OF THE NATIONAL ASSOCIATION OF CEMENT USERS at Kansas City is covered briefly in this report. The convention was a most interesting one, and many points of great interest were developed.

THE COST OF TEST LOADS is often a reason against them, as the cost sometimes seems unreasonably high. Detailed costs of comparative methods are here discussed, the author favoring the use of sand in loose boxes. This by the way, is the same method used in the analytic test referred to above.

A FIREPROOF AUTOMOBILE BUILDING with reinforced concrete columns and floors, glazed terra cotta face. The interesting feature here is a cantilever girder foundation for the wall columns.

UNIT COSTS OF CONCRETE BUILDINGS present a careful synopsis of several years experience in designing and superintending construction, economical features, especially spans, are discussed.

ESTIMATING STANDARDS in broader use will make possible the practice of *Quantity Surveying.* This article presents the report of the N. A. C. U. committee on measuring concrete.

IRON ORE CEMENT was the subject of three very interesting papers at the recent N. A. C. U. convention. An abstract of these three papers is presented.

PORTLAND CEMENT IN FRANCE DURING 1911, is discussed by M. Candlot in an interesting letter to *Cement Age.* Financial, technical, commercial and mechanical development are briefly covered.

DISCRIMINATION IN CEMENT FREIGHT RATES, is an abstract from a recent decision of the Interstate Commerce Commission, and covers the contention between Eastern and Middle West manufacturers, tracing the developments influencing freight rates down to the present time.

CONSULTATION presents a discussion on *Methods of determining Comparative Value of Sands* (216); a detailed statement of the *Cost* of a *Concrete Cornice* (234); and some additional notes from a constructing engineer on the *Storage of explosives.*

CORRESPONDENCE again takes up the question of *Quantity Surveying;* publishes a letter from a German expert on marine cement; and the possibility of an objectionable content of magnesium chloride in the commercial calcium chloride.

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THE TURNER-CARTER BUILDING, BROOKLYN, N. Y.—TYPICAL INDUSTRIAL CONSTRUCTION.

The stresses existing in the completed building under actual loading were determined by an analytical test of the structure. Deformations due to load in both concrete and steel were observed by special instruments, and from this data the stresses determined. This building, with the Wenalden Building, Chicago, has a place in engineering records, for in these buildings the first analytical tests of beam and slab construction were made.

CEMENT AGE with which is combined CONCRETE ENGINEERING

A Monthly Magazine Devoted to the Uses of Cement and Concrete

VOL. XIV **APRIL, 1912** **No. 4**

STEEL FOR CONCRETE AND THE STANDARD SPECIFICATIONS OF THE AMERICAN SOCIETY FOR TESTING MATERIALS

THE specifications for reinforcing bars reported to the American Society for Testing Materials, at their June convention, are, with a few exceptions, identical with the specifications adopted by the Association of American Steel Manufacturers, and published in CONCRETE ENGINEERING for May, and CEMENT AGE for June, 1910. The first clause allowed bars of either open hearth or Bessemer steel, but "bars shall be rolled from billets." This clause, at the time, was understood by the engineers of the industry to effectually exclude material rolled from rails. The entire specification completely ignores the fact that re-rolled or "rail carbon" steel, as it is called, is being used in large and increasing quantity. That an association of manufacturers should specify manufactured steel exclusively is not to be wondered at, but the adoption of this specification by an association of national and even international influence, is a matter of concern. Since June, 1911, correspondence has been had to obtain a modification of the specification, but without results. After the recent organization of the Rail Steel Bar Manufacturers Association, a formal hearing was applied for, and accordingly a sub-committee of the latter body was invited to appear before Committee A-1 on standard specification for steel on the evening of March 28. At that meeting action was taken in the presence of the sub-committee in question to the effect that three members of the general body of the Rail Steel Bar Manufacturers Association were formally invited to become members of the present sub-committee on reinforcement bars which consists now of three steel producers and three non-producers so that in its present enlarged form the sub-committee will be one of nine. At that time, however, under the rules of the American Society for Testing Materials, changes in specifications by which re-rolled rails could be covered could not be made, and the specification was submitted to the convention March 29, to be referred to letter-ballot, with amendments. Not only was the word "new" inserted before "billets," but the first clause amended reads as follows:

> "1. Steel may be made by either the open-hearth or Bessemer process. Bars shall be rolled from new billets. No re-rolled material will be accepted."

In view of this amended clause and its bearing upon re-rolled reinforcing bars a motion to lay the amendment on the table was made. This was lost and the convention adopted Prof. Marburg's resolution that the specification with the amendment be referred to letter-ballot, and that the society go on record as adopting these specifications without any prejudice toward other reinforcing steel.

The present position of the society is paradoxical to say the least. In adopting "Standard Specifications for Steel Reinforcing Bars" which, in the introductory clause say "Bars shall be rolled from new billets. No re-rolled material will be accepted," the society at the same time adopts a resolution that they are not prejudiced against other, or re-rolled material specifications for which it is about to consider. On the face of it, the specification covers only steel made from new billet, open-hearth or Bessemer stock, and is not a "standard specification for reinforcing steel." The point has been raised for the purpose of argument only that all bars are "re-rolled" from ingot, to billet, to bar. The term "re-rolled," to accomplish its intended purpose, should be more clearly defined.

To get above the technical points involved in the question, and the commercial strife which has existed, and probably now exists between the manufacturers of different kinds of steel, let us consider only an engineering specification as a *specification*. The value and the unimpeachable integrity of any specification lies in the belief, or better the knowledge on the part of the user, that the specification is drafted on an impartial and comprehensive study and survey of all the factors involved. The strength of a technical society is directly related to the value of its specifications, and to maintain the position of any society, specifications should be adopted only when they represent an impartial consensus of the best opinion, formed on theory, maybe, but unvariably tested and proven by experience and practice.

Between 200,000 and 250,000 tons of the material which the specification means to exclude under the term "re-rolled," that is material manufactured from the heads and flanges of rails, are used annually in

this country by its best and foremost concrete engineers and constructors. We hold no brief for rail-carbon steel. Its record will speak for itself, and with an equal opportunity based on merit alone, it needs no protective specification. Any attempt, however, to delay the prompt adoption of specifications for a material which is being successfully used in such quantities by the foremost concrete engineers of the country should be deprecated as it lessens the value of specifications as instruments for better engineering work.

As was brought out at the recent gathering of railway engineers at Chicago, it is hardly within the province of an engineering body to determine *how* a manufacturer shall make a material. Specify *what* the material must be, what work it will do, and the rest is up to the manufacturer.

Early in 1910, the National Association of Cement Users, in convention at Chicago, revised their general building specifications so that re-rolled material was not prohibited. The editorial comment on this change, in Concrete Engineering for March, 1910, seems particularly applicable at the present time, and in closing we quote from this in part as follows:

> The term "High Carbon" has been replaced in the specifications by the more definitive phrase "High Elastic Limit." The restrictions now are not put upon its source or methods of manufacture, but rather upon the quality of the steel itself, as it comes onto the work. High Elastic limit steel has been used as concrete reinforcement for some time. It has been advocated and advertised in many forms and under different names. * * * So far, standard specifications have come out point blank against "re-rolled" material, and it remained for the National Association to face the facts in the case and specify accordingly. The methods and practice of rolling "re-rolled" material have been developed and improved during the past few years, and the re-rolling mills have worked hard to develop a thoroughly good material. It is undoubtedly a fact that during the past rapid increase in the use of concrete materials, most of the "high elastic limit" steel has been rolled from the heads of railroad rails, has been "rail-carbon" steel, and this too, in spite of the fact that as a general rule, specifications have not allowed its use.
>
> We have been endeavoring for some time to gather and present the best opinion available covering both theory and practice, on what constitutes the best reinforcing material, "pound for pound and dollar for dollar." In adopting such specifications, the National Association is to be commended in not trying to disclass any one material on account of its source, especially so when this same material has been proven under other names, and, due to certain qualifications, it will be used in increasing quantities. The revised specifications contain no invalid clause, and guard all steel as it comes onto the work with rigid specifications which should make for better structural concrete.

The engineers of the concrete industry should feel called upon to guard against undue and unjust restrictions, which would in any way handicap normal development. In framing specifications for concrete reinforcement we should not be hampered by inherited ideas from the older fields. We are n.t using structural steel. Our material is structural concrete. The stresses under consideration in the steel now are not bending and shear, but almost exclusively tension and compression. Vibration and shock in any case are absent. To try to make the new requirements fit into the old conditions is hardly fair. Any attempt to do so deserves to fail.

"CONCRETE ITS OWN INSPECTOR"

THIS saying, credited to a New York engineer, is more than a merely clever statement. Just as soon as users of concrete realize how true it is, concrete failures will become a thing of the past. The man who attempts to deceive an owner or the public by "skinning" his job forgets that he has an impartial and relentless inspector in the concrete itself. It refuses to parade under an assumed name. If it isn't well-made or honest concrete it will let you know it. Too often its honesty is accompanied by death, injury and the loss of money, but it takes no account of these things in its inexorable obedience to natural or mechanical laws. The brief statement quoted above would be a good thing for every contractor to paste in his hat.

ANALYTICAL TESTS OF ACTUAL CONSTRUCTION

IN February, 1910, the National Association of Cement Users, at their Chicago convention, presented direct comprehensible mathematical analysis of flat plate design. At their 1911 convention (New York) Professor Talbot and Mr. Lord presented the results of an analytical test on actual floor construction. The details of this are well known to Cement Age readers, but perhaps it is not realized that the methods developed and the results obtained were epoch-making in the structural engineering world. Direct actual analysis of the stresses in building construction has given to the concrete engineering world and to the engineering world in general, a confidence in this material which means much.

At the 1912 convention, however, the Committee on Reinforced Concrete presented the results of analytical tests on *four* structures and to cap the climax, a paper was presented discussing solely the best methods of testing.

The National Association is to be congratulated on the valuable work it is doing in developing and presenting to the industry the results of so much intelligent, comprehensive and thorough research work.

ANALYTICAL TESTS OF BEAM AND GIRDER FLOORS

THE report of the Committee on Reinforced Concrete of the National Association of Cement Users, at its Eighth Annual Convention, Kansas City, Mo., March, 1912, was most valuable in presenting analytical tests on actual buildings under load.

In accordance with the program of tests on completed structures presented to the Association at its last convention, four tests have been made, two of them on standard forms of beam and girder reinforced concrete floors in which the concrete slab is supported by one or more intermediate beams which in turn are framed into or supported by girders carrying the load to the columns. Of the other two tests one of them is on the girderless or flat slab floor, and the other on a combination of tile and concrete floor, in which the reinforcement is placed in two directions.

These tests were undertaken for the purpose of getting information on the action of the composite structure of concrete and steel under load in a reinforced concrete building constructed under the usual conditions of work. Many tests have been made of separate reinforced concrete members, but little attention has been given to the measurement of stresses and deformations in the completed building and to the determination of their actual amount and distribution and of the effect of one part of the structure upon another.

Load-deflection tests are common and are of value in judging of the quality of workmanship and in giving confidence in the structure, but they throw little light on the stresses developed in the different parts or upon their distribution. A variety of views have been advanced on the relation between the bending moment at a section at the support and that at the middle of the beam, on the amount of arch action which may be developed in the structure, on the distribution of the stresses across a floor slab acting as the flange of a *T*-beam, on the restraint of girders and beams, etc.

The general method of test followed the plan outlined by Arthur R. Lord in the paper,* *A Test of a Flat Slab Floor in a Reinforced Concrete Building.* Holes were cut in the concrete until the reinforcing bars were bared. Gauge holes were then drilled in these bars, at distances apart to give the proper gauge lengths. Where measurements of deformation of the concrete were desired, holes were cut in the concrete and a steel plug inserted in which the gauge holes were later drilled. These gauge lines were selected in places where it was thought that critical stress would be determined. In some places for one reason or another the reinforcing bars were inaccessible and it was impracticable to obtain measurements to give information which would have been of interest. In some cases a series of gauge lines were used to determine the change of stress or distribution from one point to another as at the end of a restrained beam and across the flange slab between beams.

The measurements were made by means of Berry extensometers of the form developed at the University of Illinois. The instrument reads to 1-5000 in. and is estimated to 1-10000 in. In making measurement the legs of the instrument are inserted in the gauge holes, a reading taken, the instrument taken out and again inserted and read, and this proceeding repeated until a number of readings without serious discrepancies are found. The instrument is of a simple character, but its use requires unusual care and skill on the part of the manipulator. The method of using the instrument as well as the necessary general conditions attending such tests are comprehensively discussed in the paper presented at this convention by W. A. Slater on *Tests of Reinforced Concrete Buildings under Load.**

COMMENTS.—A few words on the basis and limitations of such tests may not be out of place. The measurements and observations are subject to

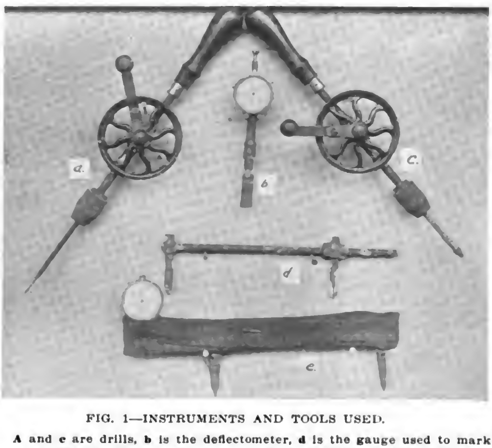

FIG. 1—INSTRUMENTS AND TOOLS USED.

A and c are drills, b is the deflectometer, d is the gauge used to mark points for drilling, and e is the extensometer. A detail of e is shown in Fig. 2.

*See N. A. C. U. Proceedings, Vol. VII, p. 156, also "Cement Age," Feb., 1911.

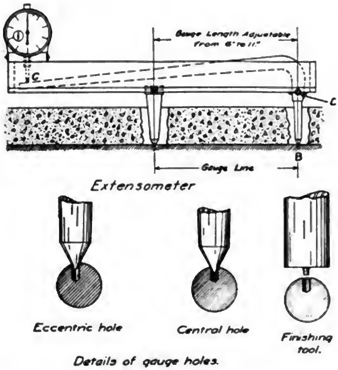

FIG. 2—DETAIL OF EXTENSOMETER AND GAUGE HOLES.

some uncertainty; they are not exact or precise—some erratic readings must be expected. The measuring instrument is used under unfavorable conditions. The gauge holes are deep in the concrete and the measurements may be interfered with by dust or other obstructing matter. Great care and much skill is necessary in making observations. Each test of this kind made has shown advances in accuracy and certainty, and further experience ought to show further progress. It must be understood that the structure itself is not entirely homogeneous and that all parts of it do not act alike. Further, the structure itself is tied together so closely that stress in one portion may be modified or assisted by another portion which may not be thought to affect it, and this in an unknown amount. The modulus of elasticity of the concrete in the structure may not be known. The load-deformation lines may be irregular and imperfect. This all means that care must be given in the interpretation of results. Important information will be brought out by such tests, as these tests show, and tests of special features of construction and an accumulation of data on the action of the structure as a whole will be worth many times the cost of the work.

WENALDEN BUILDING TEST.—The Wenalden Building, is a ten-story reinforced concrete structure at 18th and Lumber Streets, Chicago. It was built by the Ferro-Concrete Construction Company, Cincinnati, Ohio, in accordance with the plans and specifications of Howard Chapman, architect. It is now occupied by Carson, Pirie, Scott and Company, dry goods merchants, as a warehouse. The building is of the beam and girder type.

(As the methods used here were very similar to those used on the Turner-Carter building, the detail will be here omitted, and the discussion continued in detail based on the Turner-Carter building test.—EDITORS)

THE TURNER-CARTER BUILDING TEST.—The Turner-Carter building is an eight-story reinforced concrete building 60 x 200 ft., located at Willoughby Avenue and Walworth Street, Brooklyn. It was constructed by the Turner Construction Company for the Turner-Carter Company (manufacturers of shoes) in accordance with the plans and specifications of Frank Helmle, architect.

The building is of the beam and girder type. The panels are 17 ft. 4 in., by 19 ft. 6 in. The floor was built continuously with the beams and girder. The girders are 10 in. wide and 24 in. deep including the finished floor. Each panel has two intermediate beams 7 in. wide with a total depth of 18 in. The column beams are the same size as the intermediate beams. The columns below the test floor were 30 in. from face to face. The beams and girders were designed as simple beams, but reinforcement is supplied for continuity, and the construction was such as to give continuity in the beams and girders. The structure was designed for a live load of 150 lb. per sq. ft.

The aggregates were an excellent grade of sand and gravel obtained from the sand banks in Hempstead Harbor on the north short of Long Island. The gravel ranged in size from 1/8 to 7/8 in. For the beam and girder reinforcement bars having an elastic limit of about 50,000 lb. per sq. in. were used. The beams have one 1-in. square bar and two 7/8-in. square bars at the middle and one 1-in. square bar over the support carried about 15 in. beyond the center line of the girder. Ten 3/8-in. round bars placed in the slab are also available for tension reinforcement in the end of the intermediate beams, as is also one *T*-bar used for supporting the slab reinforcement during construction. The girders have two 1-in. square and three 7/8-in. square bars at the middle, placed in two layers, and two 1-in.

FIG. 3—AN EXTENSOMETER READING, ONE OF 12,000 OBSERVATIONS.

*Presented at the Eighth Annual Convention of the National Association of Cement Users, March, 1912.

square bars over the support carried nearly to the farther face of the column.

The floor tested was constructed July 25 so that at the time of the test, September 10 to 20, 1911, the work was about fifty days old.

METHOD OF TESTING.—The feature of the test, as of the Wenalden test, was the measurement of the deformations in the reinforcement and in the concrete at various points in the girders, beams, and slabs. The most important determinations taken up in the test were the measurement of the compressive deformations in the concrete at and near the supports of the beams, the compressive deformations of the concrete at the middle of the beam, and the distribution of these compressive stresses across the top of the slab between beams to determine the extent of *T*-beam action. The deformation in the reinforcement was measured at the center of the spans and at the end and also on the inclined portions of the bent-up bars. Various other measurements which it was thought would throw light upon the action of the structure were taken.

PREPARATION FOR THE TEST.—A week was used in preparing for the test. Platforms supported by scaffolding for the use of observers were built on the second floor. Independent of this was a frame work, which was supported by the second floor, for use in making measurement of deflections. The boxes for

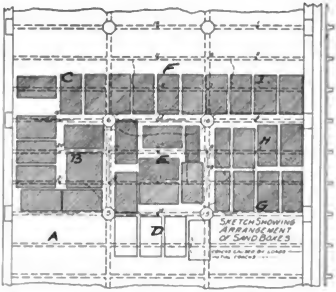

FIG. 5—PLACE SHOWING LOCATION OF SAND BOXES AND SUBSEQUENT CRACKS.

holding the sand were constructed, this being facilitated by a power saw located on the second floor. Considerable time was consumed in drilling holes in the concrete to bare the reinforcement. In some

FIG 4—PLACING THE TEST LOAD.

This shows the bottomless sand boxes arranged as shown in Fig. 5. Note the spacing left between the boxes.

cases this was found to be at a considerable depth from the surface. In all nearly two hundred holes were cut in the concrete. Holes were drilled in the reinforcing bars, as heretofore described, for use as gauge points. The gauge length was made 8 in. For use in the measurements of deformations of the concrete, holes about ½ in. in diameter and 1 in. deep were drilled in the concrete and steel plugs were inserted and set in plaster of Paris. A gauge hole for receiving the points of the extensometers were drilled in these plugs with a No. 54 drill. The deflections were measured between a steel ball set in the under surface of the beam and a ball attached to the frame work previously described.

Method of Loading.—The test area was on the third floor. The loading material was damp sand which was placed in bottomless boxes. These boxes were of various sizes and were placed in such a way as to give a well distributed load. The general size of the box was 4 ft. 6 in. wide, 8 ft. long and 4 ft. 6 in. deep. The boxes were made small enough to permit a good distribution of load even though part of the weight of the sand might be carried by arching and friction down the sides. The test area covered three full panels and parts of four others, in all equivalent to five panels. A loading space was chosen which it was thought would give the fullest stresses over the girders and beams on which the principal measurements were made. In removing the load the outer panels were unloaded first in an attempt to determine the relation between single panel loading and group loading. The load applied was the equivalent of 300 lb. per sq. ft., double the design live load.

Before beginning the test, a calibration of the heaviness of the sand was made by weighing the sand which had been shoveled into a box of 16 cu. ft. capacity placed on the scales. It was found that there was a difference of about 10 per cent. in the weight of sand which had been thrown in loosely and sand which was packed somewhat. During unloading, the entire contents of three of the sand boxes (about 500 cu. ft.) were weighed. This gave an average of 88.6 lb. per cu. ft., agreeing closely with the weights of the unpacked sand previously weighed, and this value was used in the calculation of loads.

On a part of the area where the boxes were not carried to a sufficient height and where the space was not covered adequately by them, cement in sacks was used as loading material.

The supply of sand for the loading had previously been delivered on the same floor, the piles being kept at least one panel away from the location of the test area, and this was distributed over sufficient floor space that the stresses in the beams of the test area could not be affected. In applying the load the sand was wheeled in barrows and dumped into the boxes. As the sand was placed, the sides of the boxes were rapped to break the adhesion of the sand. Some leveling of the sand in the boxes was done, but there was little compacting by tramping or otherwise.

Making the Test.—A very important element of a test of this kind is the initial observation for fixing the zero point of the test readings. Three sets of observations for a number of gauge lines were made before the beginning of the test, on the afternoon of September 10 and the forenoon of September 11. Where discrepancies were found new observations were made. Even with this number of observations there are uncertainties in some initial readings. Experience confirms the view that before

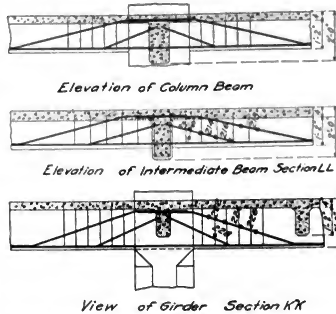

FIG. 6—DETAIL OF BEAM AND GIRDER SHOWING REINFORCEMENT AT SUPPORT.

any load is placed the initial readings which have been taken should be worked up and continued until all discrepancies and uncertainties have been removed. The total load was over 500,000 lb.

Readings were taken immediately after the completion of each increment of load and again immediately before the beginning of placing another increment of load. This usually corresponded with evening readings and morning readings. A series of readings was also taken with the full test load on. These extended over a period of 48 hours. A similar method was used in the process of removing the load.

The load was applied in increments of 100 lb. per sq. ft. based upon the whole test area. The application of the load consumed three days. The full load was left on 48 hours. In the unloading, the load on panels *B* and *C* were first removed, then the load on panels *D*, *F*, and *I*, followed by the removal of the load on panel *H*.

All instrument readings were made by W. A. Slater and H. F. Moore, of the staff of the Engineering Experiment Station of the University of Illinois. Mr. Slater had immediate charge of the test as a whole. A. N. Talbot was present during the work of preparing for the test.

Beams.—For the tensile stresses in the reinforcement at the middle of the intermediate beams at the full load of 300 lb. per sq. ft., the highest stress observed was 11,000 lb. per sq. in. and the average stress recorded may be said to be 8,500 lb. per sq. in. At the end of the intermediate beams, the highest stress observed in the reinforcement was 8,000 lb. per sq. in., and the general value may be said to be 7,500 lb. per sq. in. Using the assumptions for resisting moment ordinarily taken in design calculations, these stresses may be considered to correspond to a bending co-efficient of .05 Wl for the maximum stress at the middle of the beam and .03 Wl for the maximum stress at the end of the beam if the tensile strength of the concrete be not considered.

Assuming a modulus of elasticity for the concrete of 2,500,000 lb. per sq. in., the concrete on the compression side of the beams at the middle showed a compressive stress of 350 lbs. per sq. in. and at the

end of the beam 1,100 lbs. per sq. in. It is apparent that the total compressive stress in the concrete is greater than the total tensile stress in the reinforcement of the beams. A possible explanation is that end thrust exists, involving so-called arch action in the beams and floor structure, and that the tensile stress is relieved by the presence of this thrust. The tensile strength of the concrete must have a large effect on the resisting moment. The coefficient of *Wl* in the bending moment, necessary to give a compressive stress equal to the maximum measured in the concrete, on the assumptions made, is .077 for the middle of the beam and .07 for the end of the beam. These coefficients are lower than the value 1-12 usually assumed in design of such beams.

Girders.—For the tensile stresses at the middle of the girders the observations showed about 8,000 lbs. per sq..in. in the reinforcement at the middle. This corresponds to a bending moment coefficient of .06, again neglecting the tensile strength of the concrete. The reinforcement at the end of the girder was inaccessible.

Assuming a modulus of elasticity of 2,500,000 lbs. per sq. in., the concrete on the compressive side of the beam at the support showed a compressive stress of 900 lbs. per sq. in. The reading at the middle of the beam showed very little compression. Assuming that the loads on the girder are concentrated at the points where the intermediate beams are connected, and making the same assumption of distribution of stress as before, the coefficient of bending moment was .06. It seems probable that the compression at the middle of the span must be distributed a considerable width of floor, or larger readings of compression would have been obtained.

Decrease in Compression with Distance from Support.—In four beams measurements of compressive deformations were taken at a series of gauge lines from the support to a location near the point

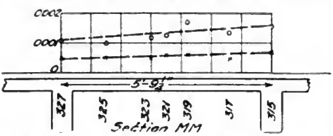

FIG. 7—DIAGRAM SHOWING DISTRIBUTION OF COMPRESSIVE DEFORMATION ACROSS FLANGE OF T BEAMS.

of inflection. It may be expected that there will be full restraint for the end of the beams. The measurements recorded for the column beams show considerably more compressive stress than do those for the intermediate beams, perhaps one-third more. This difference in stress may be due partly to the deflection of the girder, and to the deflection of the intermediate beam between its support and a point opposite the end of the column beam, which would permit a larger part of the load to be carried by the column beam. It may be due somewhat to the fact that reinforcing bars are bent down from a point at the end of the column beam, while in the intermediate beams the bars run horizontally for a foot from the face of the girder.

The direction of plotted lines indicate a zero stress at about 45 in. from the face of column in the column beams and at about 50 in. from the face of the girder in the intermediate beams. In both cases the results locate the point of inflection at about 0.22 of the clear span.

T-Beam Action.—The distribution of compressive stressses in the *T*-beam formed by a beam and the floor slab (which involves the distances away from the beam for which compressive stresses are developed) has been a fruitful source of discussion. Measurements parallel to the axis of the beam were taken on the upper surface of the floor slab immediately above beams and at intervals between them. It is apparent that a somewhat higher stress existed in one beam than in the other. Taking this into consideration, the compressive stress varies quite uniformly from one beam to the other, and the full width of the floor slab may be said to be effective in taking compression. The overhang (counting to the midpoint between beams) is 6½ times the thickness of slab. It will be noticed that the conclusions are the same as given for the Wenalden building test.

Readings were also taken on the under side of the floor slabs parallel to the beams at three places but the conditions attending the location of these points do not permit conclusions to be drawn.

Floor Slab.—Measurements were taken on the floor slab in the direction of its span at three places on the under side and at one place on the upper side immediately above one of the lower measurements These gauge lines were No. 277 on the under side of the slab close to a girder, No. 279 on the under side of the slab 5 ft. from the edge of the girder, No. 309 on the upper surface immediately above No. 279, and No. 1203 on the under side halfway between girders. As might be expected from being close to the girder and near the level of its neutral axis, No. 277 showed little deformation. The pair of gauge lines (No. 279 and 309) shows less deformation than would be calculated by the ordinary beam formula, but perhaps not less than would be the case if the tensile strength of the concrete is considered to be quite effective. The reading of No. 1203 was even smaller than 279. All the stresses found in the floor slab were low. The deformations parallel to the beams were discussed under *T*-beams.

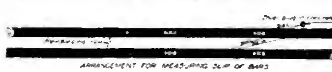

FIG. 8—ARRANGEMENT OF GAUGE POINTS TO TEST FOR MOVEMENT OF BAR RELATIVE TO CONCRETE.

Bond Stresses.—At the ends of the beams the reinforcing bars lapped over the center line of the girder a distance of 15 in. An effort was made to determine whether there was a movement of one of these bars with reference to the adjoining concrete and with reference to the adjoining bar; also whether the deformation in the stub end of the reinforcing bar was the same as in the adjoining bar. An accompanying illustration shows the location of the reinforcing bars with reference to each other, and the position of the gauge lines. No 312-14 in comparison with No. 312 and 314 will indicate any relative movement of one bar with respect to the other, and No. 312c and 314c in comparison with No. 312 and 314, respectively, will indicate any movement of the bars with respect to the concrete. It seems evident that No. 314 (on the lapped bar) records considerable less stress than No. 312. The measurements indicate a possibility that the right-hand point of gauge line No. 314 has moved to the right relatively to the right-hand point of No. 312, though this amount may not be more than the amount of initial slip necessary to develop the requisite bond stress. The measurements taken have no bearing on whether the left-hand point of No. 314

has moved. The measurements also indicate no motion of the left-hand point on the reinforcing bar (No. 312 gauge line) relatively to the concrete at its side, though it must be borne in mind that the point taken was so close to the bar that only slip and not distortion of concrete could be measured.

WEB DEFORMATIONS.—No diagonal tension cracks were visible on any of the beams or girders.

In girder 4 measurements were taken on the diagonal portion of a reinforcing bar, one of the bars which is provided to take negative bending moment. This is shown in Fig. 6, Section K-K. The gauge lines are No. *222*, *224*, and *226*. It was impracticable to measure the deformation at a point closer to the support. The measurements show about the same stress at No. *222* and *224*, perhaps 5,000 lbs. per sq. in. The stress at No. *226* is materially less. It is not improbable that there was tension in this rod throughout its length. As there was considerable compression measured in the gauge lines on the bottom of the girder below No. *222*, it seems probable that a crack was formed in the top of the floor slab somewhere above No. *222*, but as this space was filled in with bags of cement no observation was made during the test, and inspection of this space after the load was removed seems to have been overlooked. At the other end of the girder, a fine test crack was found on the upper surface of the floor 2 in. from the face of the column extending across the width of the girder and beyond. This extended through the floor.

Gauge line No. 228 is on a stirrup. This stirrup is in an inclined position. It is not known what bar it is intended to be connected with, nor whether there is connection with a tension bar. The gauge line is in a region of the beam where horizontal compressive stresses may be expected. The measurement in the stirrup at the first increment of load shows tension and subsequent increments give compression. It should be noted that readings could not be taken on the upper end of the stirrup. If the upper ends are merely bent out into the floor slab it is hard to see that the stirrup may be expected to be useful in transmitting web stresses.

In beam (Section L-L, gauge line No. *212*) measurement was taken on the diagonal portion of a reinforcing bar which is carried through the girder at its top and a few inches beyond. This shows a tension of 3,000 to 5,000 lbs. per sq. in. This bar was inaccessible from the top of the floor, but the gauge lines on the companion bar (No. 324 and 318) show about 5,000 and 9,000 lbs. per sq. in. Measurements in the diagonal portion of a single-bend bar (gauge lines No. 216 and 214, Fig. 19) which extends only to the center of the supporting girder indicate a small compression in the bar. A stirrup, which like the one in the girder, was close to the end of the beam and was inclined so that its lower end was nearer the support than its upper, showed shortening of the stirrup (see gauge line No. *212*). In both cases, the arrangement was such that the stirrup could hardly be effective.

The amount of the vertical shear in the beams and girders was such that diagonal tension cracks might be expected except for the small tensile stresses in the top of the girder and the end constraint which seems to have been developed in both beams and girders.

DEFLECTIONS.—The deflections of the beams (including that due to deflection of girder) and the deflection of girders are given in Fig. 10. The effect of time upon the deflection is shown by the increase in deflection under constant load. The change when portions of the load had been removed may be due in part to the time element and in part to the effect of location of the load on the panels.

Day	Date	Observations: Load, lb. per sq. ft.	Observations: Hours	Loading: lb. per sq. ft.	Loading: Hours	Observations: Load, lb. per sq. ft.	Observations: Hours.
Sunday	9-10-11	0	12 M. to 2 P. M.				
Monday	9-11-11	0	7 20 to 12 M.	100	1 30 to 6.00 P. M.	100	6 10 to 8.00 P. M.
Tuesday	9-12-11	100	6.30 to 8.15 A. M.	200	10.30 A. M. to 3.00 P. M.	200	3.10 to 5.30 P. M.
Wednesday	9-13-11	200	6.20 to 8.20 A. M.	300	9.00 A. M. to 3.30 P. M.	300 300	3.50 to 5.50 P. M. 10.30 to 11.30 P. M.
Thursday	9-14-11	300	8.00 to 8.30 A. M.			300	3.00 to 3.30 P. M.
Loading Schedule							
Friday	9-15-11	300	7.30 to 9.30 A. M.	300 on *D, E, F, H,* and *I.*	3.30 to 7.30 P. M.	300 on *D, E, F, H,* and *I.*	8.00 to 8.30 P. M.
Saturday	9-16-11	300 on *D, E, F, H,* and *I.*	7.20 to 9.15 A. M.	300 on *E* and *H.*	9.30 to 11.45 A. M.	300 on *E* and *H.*	6.30 to 8.00 P. M.
Monday	9-18-11	300 on *E* and *H.*	6.15 A. M. to 9.20 A. M.	300 on *E* only.	9.30 A. M. to 12.00 M.	300 on *E* only.	12.15 to 1.50 P. M. 4.15 to 8.00 P. M.
Tuesday	9-19-11					300 on *E* only.	4.50 to 6.50 P. M.
Wednesday	9-20-11	300 on *E* only.	8.30 A. M. to 12.30 P. M.	Zero	1.00 to 3.40 P. M.	Zero on all bays.	4.00 to 5.40 P. M.

FIG. 9—SCHEDULE OF LOADING OPERATION.

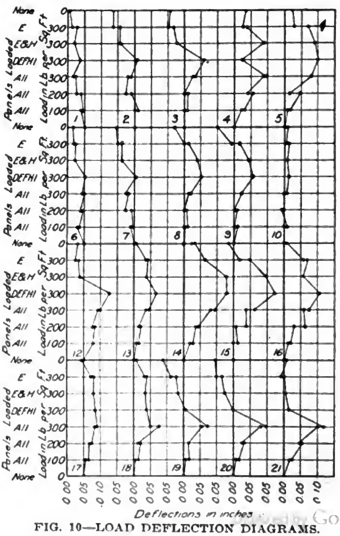

FIG. 10—LOAD DEFLECTION DIAGRAMS.

Member	Gauge Line	Reinforcement.	Gauge Line	Concrete.
End of girder	.	......	269	900
Middle of girder	220	8,000	311	Little
"	244	9,000	...	......
End of beam	304	8,000	265	1,100
"	318	8,000	267	1,100
"	310	4,000	281	1,000
"	...	......	293	800
Middle of beam	202	7,000	301	350
"	206	11,000	305	350
"	230	9,000	313	200
"	234	8,000	315	300
"	236	8,000	...	......
"	238	11,000	...	......
"	240	5,000	...	......
Bent up bar in girder	222	5,000	...	......
"	224	5,000	...	......
Bent up bar in beam	214	3,000	...	......

FIG. 11—STRESS INDICATIONS IN TURNER-CARTER BUILDING TEST.

The deflections seem relatively small, especially when compared with deflections obtained in laboratory tests of beams carrying the same loads. The effect of the time element is indicated on these diagrams. The conditions were such that the supports were subject to possible displacement by workmen.

Columns.—Readings were taken on the four faces of one of the columns just below the girders, but the results are not consistent enough to warrant attempting drawing conclusions.

Test Cracks.—Fine tension cracks were observed in the lower part of the beams and girders. The appearance of these fine cracks is similar to those observed in laboratory tests. They would not be noticed without specially careful examination.

Member	Reinforcement		Concrete	
	Stress	Coefficient	Stress	Coefficient
Girder, End	31,000	1/12	1,200	1/12
" End	....	....	900	0.06
" Middle	12,500	1/12	300	1/12
" Middle	8,000	0.05	Little	
Intermediate Beam, End	21,500	1/12	1,300	1/12
" End	8,000	0.03	1,100	0.07
" Middle	18,500	1/12	380	1/12
" Middle	11,000	0.05	350	0.077
Column Beam, End	19,600	1/12	1,200	1/12
" End	....	....	950	0.064
" Middle	17,000	1/12	350	1/12
" Middle	10,000	0.05	225	0.054

FIG. 12—MAXIMUM STRESSES AND MOMENT CO-EFFICIENTS IN TURNER-CARTER TEST.

The floor cracks already mentioned indicate the development of the tensile stresses in the beams and girders at the support.

The limitation of space and time have prevented the presentation of other matters which were observed in the tests. For example, the observations on deformations during the 48 hours time with the full loading showed in general a slight increase in the deformations in the reinforcement and in the concrete. It is hoped to take up some of these matters at another time. It was not possible to give full attention to every feature upon which information was sought, and in some cases isolated points were used with a view of determining tendencies, and in these naturally there is less certainty in the indications.

Additional Notes.—Fig. 12 gives calculated stresses and calculated bending moment co-efficients. The first line of each set gives the calculated stresses in the reinforcement and in the concrete based upon the value of the bending moment quite commonly assumed in design calculations, 1/12 *Wl*, where *W* is the total distributed load on the beam and *l* is the span length. In these cases the span length was taken as 3 in. longer than the clear span. Measurements had been made upon the position of the bars and the depth of the reinforcement, which were not always exactly according to the plans, and the calculations have been based upon the dimensions found. In the second line of each group the maximum stress obtained by the measurements is given in the column of stresses, and the bending moment co-efficient (the co-efficient of *Wl*) corresponding to these stresses is recorded in the adjacent column. In these calculations the common assumptions of design calculations (including the neglect of the tensile strength of the concrete) are followed except that the width of T-beam is taken as equal to the distance from center to center of beams. In calculating the bending moment co-efficient from the measured stress, the position of the neutral axis and the value of the moment arm are assumed to be the same as given by the ordinary assumptions. Although the stress in the reinforcement is measured at the surface of a bar of the outer layer, this stress is considered as being the same as that acting at the center of gravity of the group of bars, for the actual variation in the group is unknown and this method will give a bending moment co-efficient larger that that found by considering that the stress in the bars of the other layer is smaller.

Prof. Talbot calls attention to the fact that in the calculations for compressive stresses, the compression reinforcement was considered to take its proportion of compressive stress, though there may be a question whether the embedment in such design is sufficient to insure this condition.

Economical Thickness of Sheathing for Building Construction

Studies from unit costs, says *Building Age*, show that 1-in. lumber, that is, ⅞-in. after dressing, averages for column forms about 16 per cent cheaper to make and about 7½ per cent cheaper to erect the first time than 1½-in. stock. The 1-in. (⅞-in.) is about 15 per cent cheaper to erect the first time than 2-in. This lighter stock is easier to patch also than the heavier. On the other hand, 1-in. stock is not so durable and is more apt to break when removing the forms, so that thicker material is advisable in certain cases where it has to be used a large number of times.

As to cost of material, the thicker sheathing permits spacing of studs or joists further apart, but since the quantity of lumber in the studs or joists is apt to be governed by the strength required to resist the weight or pressure, the saving in material here is not enough to balance the excess cost of the thicker sheathing.

In general, therefore, 1-in. stock (⅞-in. dressed) is recommended for slab forms and for sides of beam and girders. For the bottoms of beams and girders, 2-in. stock (1⅞ or 1¾ in. after dressing) should be used for ordinary work and 1½-in. for narrow members. For columns 1½-in. stock is recommended because of its greater durability.

THE NATIONAL ASSOCIATION OF CEMENT USERS

EIGHTH ANNUAL CONVENTION, KANSAS CITY, MO. MARCH 11—16, 1912

THE decision to hold the annual convention of the National Association of Cement Users at Kansas City was made after careful consideration of all the factors involved, and while it was realized that the Association, strong in the East, would lose much of its eastern attendance, yet the position was taken that the Association should go where it could do the most good, and not where its attendance numerically, would necessarily be strongest. The results fully justify this position, and the Association held a convention which has meant much toward furthering a better understanding of concrete, a keener appreciation of its use, and those standards of practice which make for successful work.

Opening Session, Friday, March 11

FORMAL OPENING OF THE CONVENTION HOTEL BALTIMORE.

ADDRESS OF WELCOME ON BEHALF OF THE ENGINEERING INTERESTS—J. L. HARRINGTON, Past President, Engineers' Club of Kansas City; Waddell and Harrington, Consulting Engineers, Kansas City, Mo.

The program, in opening, called for an address of welcome by the mayor of Kansas City, the Honorable Darius A. Brown, but by some mishap, he was detained, and the first address was by Mr. Harrington, who outlined and showed the subjective and objective value of association work. In olden time, and even well into the past century trade or professional knowledge was in the main, guarded as secrets. Some time ago, the formation of the English Society of Civil Engineers started a new era in engineering lines. This, followed by the rapid formation of associations in specialized engineering lines, showed the real value of such societies. The interchange of ideas, of successes and failures, which the various societies have made possible, has been a stimulus for greater effort and far-reaching achievement. The National Association of Cement Users is a specialized association for the study of the uses of cement, and when it is realized that we are in this country spending about $500,000,000 annually for concrete construction, the value of the work the Association can do is evident.

As far as failures are concerned, they can generally be reduced in the last analysis, to be due to the mad scramble for lower prices, and cheaper work. One failure works adversely toward the entire industry, and it is the duty of the Association to so elevate standards of construction, that failures will be out of the question. This is essentially an engineering question, and the Association today is, essentially, an engineering body, just as reinforced concrete is an engineering material.

ADDRESS OF WELCOME ON BEHALF OF THE CONCRETE INTERESTS—F. W. FRATT, President, Union Bridge and Terminal Railroad Co., Kansas City, Mo.

Mr. Fratt, in his address, used an interesting simile in showing that a welcome from the concrete interests was a welcome from everybody. Not very long ago, wooden sidewalks were here so common as to be almost universal. Now concrete is the rule, and its so evident superiority in this use, especially in contrast with wood, has merited the interest of everybody. And so the "concrete interests" is a very broad term, and the welcome to the Association came from every quarter.

THE USE OF REINFORCED CONCRETE IN HYPOCHLORITE WATER PURIFICATION WORKS—DR. WALTER M. CROSS, City Chemist, Kansas City, Mo.

Dr. Cross discussed in an interesting way the use of concrete in hypochlorite purification plants, and while no construction details were given, it is of interest to note that he stated that concrete was the only material which was suitable for such structures. Where metal parts are needed, bronze is the best material to use.

THE USE OF CONCRETE IN THE NEW UNION STATION—GEORGE E. TEBBETTS, Engineer, Kansas City Terminal Railroad Co., Kansas City, Mo.

The Kansas City Terminal development involves about $40,000,000, mostly in concrete construction, and is the joint work of 12 trunk line railroads to build a big Union station. The talk by Mr. Tebbetts was an informal discussion of many photographs thrown on the screen. Probably the most interesting feature was the unit or pre-cast construction used in the various short span bridges. In this, all the work is pre-cast, except the column footings, and the abutments.

The columns are reinforced with a 4-angle built-up frame, to which is added ordinary square reinforcing bars as required, and the entire longitudinal frame wrapped with mesh. An angle collar was provided at the base by which the columns will be bolted to the foundations for stability during erection. The slabs used are very heavy, weighing about 40 tons. After units are cast, they are kept wet by sprinkling, and there has been very little checking. Part of the work was the construction of a diverting channel, a double-box sewer about a mile long, and with an approximate area of 450 sq. ft., reinforced concrete throughout.

Well designed concrete plants handle materials economically, and engineering thoroughly in

sympathy with reinforced concrete is being shown at every point.

Tuesday, March 12th

There was some delay in opening the program, and the opportunity was taken to discuss the mechanical developments in placing concrete mortar with special reference to the "cement gun." The question was brought up by Willis Whited, who is now Bridge Engineer for the Pennsylvania State Highway Department, and who is facing the problem of repairing numerous stone masonry highway bridges.

MEETING OF THE SECTION ON MEASURING CONCRETE, NOMENCLATURE, AND SPECIFICATIONS AND METHODS OF TESTS FOR CONCRETE MATERIALS.

Topical discussion on methods of measuring concrete construction, and on materials used for concrete.

In Mr. Thompson's absence the report of the Committee on Specifications was read by Mr. Chapman. This was a tentative report and printed for information of members and to develop discussion and suggestion. An earnest request is sent out to all testing laboratories that they contribute their experience toward formulating standard methods of testing concrete materials. Members are urged to advise the committee of testing laboratories that do such work. The Committee believe that:

To eliminate variations in result, due to the difference in laboratory conditions and the personal equation of the operator, the test always must be a comparative one. For comparison, standard Ottawa sand which is used for cement tests, and which every well-equipped laboratory should be provided with, is recommended.

The Joint Committee on Concrete and Reinforced Concrete in their 1908 report, makes the following recommendation for this test of strength:

> Mortars composed of one part Portland cement and three parts fine aggregate by weight when made into briquettes should show a tensile strength of at least seventy (70) per cent. of the strength of 1.3 mortar of the same consistency made with the same cement and standard Ottawa sand.

While this requirement is far in advance of usual practice, where no laboratory tests are required, it is not so severe as should now be demanded in the present state of the art of reinforced concrete construction. The committee is not yet prepared to recommend a fixed value for the ratio of strength for acceptance. It is suggested for the present that the ratio be set to suit individual requirements.

To avoid the removal of any coating on the grains which may affect the strength, bank sand should not be dried before being made into mortar, but should contain natural moisture.

President Humphrey, in commenting on this from the chair, said that there was no reason why under present conditions, tests with field material should not equal that with Ottawa sand.

DISCUSSION ON AGGREGATES FOR CONCRETE—WILLIAM M. KINNEY, Assistant Inspecting Engineer, Universal Portland Cement Co., Pittsburgh, Pa.

The discussion of aggregates for concrete by Mr. Kinney was a most valuable paper. Failures in concrete work are due to a combination of contributing factors, any one of which would hardly cause a failure. The example cited to illustrate this was the construction of some bridge piers, which were run while cold weather was approaching. Although every precaution was taken, the piers spalled, showing typical frost action, and the contractor, a man of reputation and experience, was at a loss to account for it. Following a detailed photo of the spalled piers, a detail view of the gravel bank from which the material was taken, was thrown on the screen, and the cause of the failure was shown. Badly assorted gravel, and streaks of clay were evident, which latter had undoubtedly delayed the set of opened the way for freezing. A surprising failure to appreciate the necessity of a thorough study of concrete aggregates is regrettably prevalent, but engineers generally are awakening to this fact, and better workmanship is promised.

REPORT OF THE COMMITTEE ON MEASURING CONCRETE—ROBERT A. CUMMINGS, Pittsburg, Pa.

The report on standard methods of measuring concrete was read by Mr. Boyer. By establishing standard methods of estimating, the way is opened to some extent toward the establishment of "quantity surveying." As this latter question has already been discussed in these columns, the report of the committe, together with the proposed rules, is published elsewhere in this issue.*

ANNUAL ADDRESS BY THE PRESIDENT.

The President's annual address was an informal description of lantern slides showing typical European concrete work. Centrifugal service poles† were shown, and also poles of the "Saxonia," or recangular cellular type.‡ Vienna has adopted concrete pavement extensively and throughout Europe the uses of concrete are progressing most encouragingly.

Mr. Humphrey urged especially that attention be paid to the beautiful utility of concrete in interior exposed construction. Artistic examples of European structures were shown.

*Page 190. "Estimating Standards and The Quantity Surveyor."
†Described in "Cement Age," March, 1911.
‡"Cement Age," November, 1911, page 219.

THE DESIGN AND CONSTRUCTION OF THE HOLLOW REINFORCED CONCRETE DAM OF THE PORTLAND RAILWAY LIGHT AND POWER COMPANY—H. V. SCHREIBER, Managing Engineer, Sellers & Rippey, Philadelphia.

DISCUSSION OF THE ADVANTAGES AND COMPARATIVE COST OF THE HOLLOW CONCRETE DAM—W. L. CHURCH, President, Ambursen Hydraulic Construction Company, Boston, Mass.

The general problems involved in the construction of a reinforced concrete dam in the State of Washington were described by Mr. Schreiver. Concrete was not only used throughout the structure itself, but grout was driven by pneumatic pressure down into the seams of the rock foundations. The geologic foundation was of a non-homogeneous volcanic rock, and every precaution was taken to erect a permanent structure. Mr. Church's paper was read by title.

CEMENT COATINGS IN COLOR—F. J. MORSE, Heath and Milligan Manufacturing Company, Chicago, Ill.

In regard to concrete surface coatings, it is to be regretted that Mr. Morse inadvertently created a wrong impression in trying to show under what conditions concrete surfaces might need a painting treatment. It is self-evident that much poor work would be improved with good surface treatment, and that this same treatment, by preventing or postponing deterioration in poor work, makes it to all intent and for the time, good work. Mr. Morse discussed the subject in an interesting way, and was frank in admitting that *good* concrete work, suffering no appreciable deterioration, needs no surface treatment. It might be added in passing that the subject could also be approached from the architectural point of view, for very often the designer wants to work out a color scheme, wherein the natural grey of concrete does not fit, and tinting, or surface treatment of some kind, becomes necessary.

REPORT OF THE COMMITTEE ON TREATMENT OF CONCRETE SURFACES—L. C. WASON, Chairman.

The Committee on Concrete Surfaces submitted a general discussion of amendments to the report submitted last year. The consideration of these was postponed to a later session. The specifications on waterproofing surfaces were referred to the Committee on Specifications.

The report of the Committee on Insurance was read by title and will be included in the Proceedings of the Association.

Wednesday, March 13th

THE PRACTICAL DESIGN OF REINFORCED CONCRETE FLAT SLABS—SANFORD E. THOMPSON, Consulting Engineer, Newton Highland, Mass.

The paper on flat slabs, in Mr. Thompson's absence, was read by Mr. Humphrey. The paper was criticised as not being based on practice, and using assumptions which might not be justified on actual work, but methods and conclusions have been closely checked with the results of the flat slab tests of a year ago, and a conservative design analysis has been developed. The paper is a valuable addition to the Proceedings of the Association.

REPORT OF THE COMMITTEE ON REINFORCED CONCRETE AND BUILDING LAWS—A. E. LINDAU, Chairman.

The report of the committee on reinforced concrete was especially noteworthy. During the past year, at a cost of many thousand dollars, four analytical tests on actual building construction have been made, and the data presented to the convention is remarkable. Tests were made on three types of floors, as follows:

Beam and girder construction, the Wenalden building, Chicago, and the Turner-Carter building, New York.

Flat slab, solid reinforced concrete, the Powers building, Minneapolis.

Flat slab, two-way tile and concrete joist construction, test panel at the Barr building, St. Louis.

The papers were an exceedingly interesting and valuable report, and speak well for the work the committee has done during the past year.

BUSINESS SESSION
Report of the Executive Board.
Election of Officers.
Place of Next Convention.

The Report of the Executive Board was received, amendments to the By-Laws adopted, and a resolution in regard to changing the name of the Association, together with the question of the place of the next convention, were referred to the Board of Direction. The officers for 1912 were re-elected and are:

Pres., Richard L. Humphrey, Philadelphia, Pa.; 1st vice-pres., Edward D. Boyer, Catasauqua, Pa.; 2nd vice-pres., Arthur N. Talbot, Urbana, Ill.; 3rd vice-pres., E. S. Larned, Boston, Mass.; 4th vice-pres., Ira H. Woolson, New York, N. Y. The committees were also re-appointed practically as they stood last year.

THE TESTING OF REINFORCED CONCRETE BUILDINGS UNDER LOAD—W. A. SLATER, Assistant Professor, University of Illinois, Urbana, Ill.

Prof. Slater discussed in a very interesting way some of the essential problems to be overcome in securing accurate test data. Seven reinforced concrete buildings have been tested since the Webber-Deere test reported a year ago, and the methods and apparatus used have been constantly improved. The paper was a detailed discussion of the way in which the tests were carried out, and was clearly indicative of the advances made in an intelligent comprehension of the elements of reinforced concrete design and construction. A test requires on an average 12,000 individual readings, and no small work is required to collate and interpret this mass of data. The directors of this work seem to be the "personification of precision." The paper was of especial value in connection with the four tests which had been presented.

THE DESIGN OF CONCRETE FLAT SLABS—F. J. TRELEASE, Engineer, Corrugated Bar Company, Chicago, Ill.

In the absence of Mr. Trelease, the paper on the design of flat plates was read by Mr. Lindan. This paper appears in abstract in other pages of this issue, but it may be mentioned in passing that the method described was the actual observation of the action of at flat homogeneous plate supported by columns under uniform load.

*The report on the beam and girder floor test is published on page 171 of this issue.

A flat homogeneous plate (rubber) was placed over a box fitted with model columns, and loaded with atmospheric weight by exhausting the air below. Elastic deflection of the plate was observed by co-ordinated microscopic readings, and certain deductions drawn therefrom. While the low modulus of elasticity of the rubber plate did not give conditions exactly analogous with concrete, and catenary action was present, yet the work was most ingenious and valuable.

Prof. Talbort, in discussing this, brought out the fact that concrete, submitted to pressure in two directions, is stronger than when stressed in one direction only. Experiments conducted on a cross in two-way flexure showed this by breaking uniformly in the arms.

THE PRESENT STATUS OF UNIT CONSTRUCTION—JAMES L. DARNELL, Manager, Unit Construction Co., Kansas City, Mo.

Unit construction was discussed by Mr. Darnell, who reviewed the practice of the last few years, and showed photographs of some interesting work* which is now being done at the St. Louis plant of the National Lead Co.

ADDRESS OF WELCOME TO KANSAS CITY—THE HONORABLE DARIUS A. BROWN, MAYOR.

At the evening session, Mayor Brown of Kansas City welcomed the convention. By some misunderstanding of arrangements this had not been delivered Monday night.

THE USE OF REINFORCED CONCRETE ON THE WABASH RAILROAD—A. O. CUNNINGHAM, Chief Engineer Wabash Railroad, St. Louis, Mo.

Concrete in railroad work was described by Mr. Cunningham, who showed interesting slides of the developments in railroad bridge work.

THE DESIGN OF THE REINFORCED CONCRETE DOME OF THE ST. LOUIS CATHEDRAL—HUGUES BRUSSEL, President, Reinforced Concrete Company, St. Louis, Mo.

The paper on the St. Louis Cathedral was read by title only. The convention heard with sorrow that a death in the family of Mr. Burssel had made it impossible for him to attend.

THE DESIGN AND CONSTRUCTION OF A REINFORCED CONCRETE DOME, 220 FOOT SPAN—DR. S. J. TRAUER, City Building Engineer, Breslau, Germany.

A dome for a public building at Breslau is the largest in the world. In a competitive estimate against steel, reinforced concrete proved less costly. An abstract of this paper will appear in a later issue.

THE DESIGN OF CONCRETE GRAIN ELEVATORS—E. LEE HEIDENREICH, Chief Engineer, Builders' Material Supply Co., Kansas City, Mo.

The design of concrete grain elevators, and their general features were discussed by Mr. Heidenreich. The development in this use of concrete has been phenomenal. It is to be noted that the author used oil-concrete successfully in some of his work.

*Described in "Cement Age", June, 1911.

THE SUITABILITY OF CONCRETE FOR GAS HOLDER TANKS—HERBERT W. ALRICH, Engineer, Consolidated Gas Co., New York, N. Y.

The paper by Mr. Alrich on gas holders was hardly favorable to concrete, and was read by Mr. Humphrey mainly to arouse interest in the subject and to open the way for a reply. Papers on this will be presented at the next convention of the Association.

THE NECESSITY OF FIELD TESTS FOR CONCRETE.—FRITZ E. VON EMPERGER, Consulting Engineer, Vienna, Austria.

The control-beam was described in a paper by Dr. Von Emperger of Vienna, and read by Mr. Krauss. This subject has been discussed previously in CEMENT AGE.*

Thursday, March 14th

THE DALLAS OAK CLIFFE VIADUCT—IRA G. HEDRICK—Consulting Engineer, Kansas City, Mo.

CONCRETE HIGHWAY BRIDGES—WALTER SCOTT GEARHART, State Highway Engineer, Manhattan, Kansas.

Due to illness of Mr. Hedrick, his paper was read by title, and the morning session was opened by Mr. Gearhart's paper on concrete bridges. This paper, based on experience in county and state highway work, was an emphatic exposition of the value of concrete in such work. The talk was informal and, in the main, descrriptive of a very excellent series of slides. Photos illustrated in a striking manner the disastrous inefficiency of steel or wooden bridges. Slide after slide showed failure of steel bridges, and Mr. Gearhart's terse summary of the way taxpayers' money had been wasted, spoke volumes. Poorly-designed steel bridges have cost money, but wooden bridges, or timber bridge floors have cost lives. Several slides showed traction engines lying wrecked in the creek bottom, and Mr. Gearhart's laconic explanation, which usually ended with "two men killed," drove home with emphasis the necessity of safe highways. Safe bridges are more important to highways than the road surface, for unsafe bridges mean lost life.

Bridges are an integral part of highway work, and so far in Kansas, the steel and wooden bridges have been the most expensive part. Of $3,000,000 spent in that State for highway work, $2,000,000 went into bridges.

The standard design follows generally through-girder design, with crosswise supported slab, all reinforced concrete. Mr. Gearhart said that "bridges built for 24 tons held 640 tons, and that a road roller going across had no more effect on it than rolling a marble across it."

A photograph of Kansas highways with sunflowers on each side of the road right across the bridge, was of interest in showing the way in which a concrete bridge becomes a part of the road struc-

*November, 1911; February, 1912; and under "Correspondence," December, 1911; February, March, 1912. An editorial discussion by Dr. Von Emperger will appear in the May issue.

ture. There is no break. The highway is continuous. The paper throughout was a remarkable exposition of the wonderful value of concrete bridges.

CONCRETE BRIDGES—DANIEL B. LUTEN, Consulting Engineer, Indianapolis, Ind.

Concrete arch bridges were described by Mr. Luten. Colored slides were very artistic, and Mr. Luten spoke on the comparative value of arch and girder bridges. The remarkable showing of the bridge at Monterey, Mexico, and other concrete bridges under flood, was of great interest.

FLAT SLAB BRIDGES—WILLIAM H. FINLEY, Assistant Chief Engineer, Chicago and Northwestern Railroad, Chicago, Ill.

The paper by Mr. Finley was read by President Humphrey, and the morning session closed with a most interesting discussion of bridge design. A resolution was adopted authorizing the executive board to appoint a committee to report on standard specifications for bridges and culverts.

THE NECESSITY FOR GOOD ROADS—LOGAN WALLER PAGE—Director, Office of Public Roads; President American Good Roads Association, Washington, D. C.

The evening session was opened by Mr. Page's paper on good roads, which was read by Mr. Eldridge of that department, which was a general discussion of the subject with special relation to the work of the Office of Public Roads.

THE NECESSITY OF NATIONAL AID IN GOOD ROADS—H. C. GILBERT—Presiding Judge, Jackson County, Kansas City, Mo.

This was followed by Judge Gilbert's paper on the need of Nationad aid. In the early days of the Republic, the need of National highways was recognized, and the Cumberland pike, and other roads were started The phenomenal growth of railroads in the United State, overshadowed and crowded out the highwaywork, so that today we have the finest railway, and the worst highway systems in the world. The relation of highways to agriculture was emphasized, and the point was made that, as no civilization can exist without farms, and as no farms can exist without highways, also as no great system of highways can exist without National aid, logically such aid is directly necessary to our civilization.

This is along the line of recent CEMENT AGE editorials on the "Two-billion Dollar Mud Tax," and the discussion of mechanical haulage in the March issue. We are now completing a cycle in the development of means of travel. Individual use originally required the highway, until railroads, or communal travel, overshadowed highway development. Now however, automobile, motor truck, and steam traction, have brought back individual communication and transport, and efficient permanent highways are imperative.

CEMENT PAVING AS CONSTRUCTED AT MASON CITY, IOWA—F. P. WILSON, City Engineer, Mason City, Iowa.

Mr. Wilson discussed concrete pavements, and presented the specifications covering such work in Mason City, Iowa.

AN IMPROVED CONCRETE PAVEMENT—E. W. GROVES—City Engineer, Ann Arbor, Mich.

Biluminated concrete pavement as developed in Ann Arbor, Mich., was described by Mr. Groves. This method, which has been described in detail in previous issues of CEMENT AGE consists essentially in covering the top of a concrete pavement slab with tar and sand. When the concrete is a week or so old, tar is sprinkled and brushed in, and sand is applied and rolled in. This gives a good service, is not slippery, can be easily renewed, and insulates the concrete against extremes of moisture or temperature.

REPORT OF COMMITTEE ON ROADWAYS, SIDEWALKS AND FLOORS—C. W. BOYNTON Chairman.

The report of the committee on roads and sidewalks was read and discussed. The *pro* and *con* of expansion joints excited much comment, and the weight of opinion seemed in favor of one course work.

Friday, March 15th

MEETING OF THE SECTION ON ROADWAYS, SIDEWALKS AND FLOORS.

Topical discussion covering the preparation of materials, laying, finishing, costs.

The morning session opened with the usual "experience" meeting, a practical discussion which centered mainly on the matter of "dusting" of floor surfaces. This trouble, it seems, reduces very much to the personal equation in laying the work. It may be stated generally that concrete in itself will not dust or abrade materially under wear. When in laying a floor, however, the cement and any fine dusty material in the sand is worked to the surface by floating and trowelling, dusting necessarily follows. A right consistency of the mix and a minimum of trowelling will go far toward avoiding this trouble. Larger floats and trowells, 24 ins. long and more, are being used.

CONCRETE FENCE POSTS—L. J. HOTCHKISS, Assistant Bridge Engineer, Chicago, Burlington and Quincy Railroad, Chicago, Ill.

The paper on fence posts by Mr. Hotchkiss was a very good detailed discussion of the methods used by railroads to manufacture concrete fence posts. An abstract of this paper will appear in a later issue.

THE DESIGN OF REINFORCED CONCRETE RETAINING WALLS—JOHN M. MEADE, Engineer Eastern Lines, Santa Fe Railroad, Topeka, Kans.

Retaining walls were discussed in the paper by Mr. Meade, who brought out the relative advantages of gravity and cantilever types. Speaking in favor of the heavy gravity types, Mr. Meade insisted that a wall "had to have enough stability or it would go to pieces of its own smallness." Footings are a most important consideration, and piles are recommended as affording a higher factor of safety. Care must be taken in back fill to provide for drainage. Weep-holes are too often inactive and precaution

must be taken to fill the space behind the hole with open material. Porous drain tile are not as good as bell-ended laid without mortar. The alignment is better.

Advantages and Durability of Cement Sewer Pipe —GUSTAVE KAUFMAN, Chief Engineer, The Wilson and Baillie Manufacturing Company, Brooklyn, N. Y.

The paper by Mr. Kauffman, read by Mr. Humphrey, opened the tile symposium. This paper covered the subject with special reference to Brooklyn, New York. Here the records show that renewals have been less for concrete than for clay. An abstract of this paper appears elsewhere.

Methods of Testing Cement Pipe—DUFF A. ABRAMS, Assistant Professor, University of Illinois, Urbana, Ill.

The paper by Mr. Abrams was read by Prof. Slater. This will be published later in Cement Age, practically in full.

The Manufacture and Use of Cement Drain Tile—CHARLES E. SIMS—Worthington, Minn.

The paper by Mr. Sims was in the main a statistical review of the cement tile industry. This industry must now make every effort to establish outlined practice making for a uniform product. Standards of absorption and strength must be established. The future of cement tile development tends toward localized unit plants supplying surrounding territory. tory.

Report of the Committee on Building Blocks and Cement Products—P. S. HUDSON, Chairman.

The report of the Committee on Cement Products was submitted by Mr. Arp.

The Banquet: The Friday evening session was the Annual Banquet, held at the Hotel Baltimore. About 125 were present, and in every way it was a most enjoyable occasion. George H. Forsee, Industrial Commissioner of the Kansas City Commercial Club was toastmaster, and the first speaker, John B. Pew, an attorney of Kansas City, discussed in general the industrial questions of the day, the necessity of lawyers for their solution, and their ultimate development along the line of the greatest good for the greatest number. The next speaker, John T. Harding, also a Kansas City lawyer, spoke of the greatness of the builder, the grandeur of building. "The man who builds a skyscraper is greater than he who sinks a battleship." Speaking of the permanence of concrete he said that "although the ages have done away with the mountain ranges, they have not left a finger mark on the antiquity of concrete." The last speaker was the Rev. C. E. Loos, of Clay County, Missouri, who spoke forcibly on the *doing well* of things. The best epitaph a man can have, he said, is that "He did his best." "Concrete men destroy nothing but take out of the earth the material of the dead and rear it to the glory of the living." Singing "America" closed the evening, and everybody felt better and stronger for the good fellowship and cheer which was everywhere evident.

Saturday, March 16th

Waiting for an opening of the discussion standard tile specifications were discussed. This centered around wall thickness, and the relative value of 1/10 or 1/12 diameter, for sizes between 18 and 30 in.

Some Notes on the Value and Comparative Cost of Reinforced Concrete Telegraph Poles—GEORGE GIBBS, Consulting Engineer, Pennsylvania Railroad, New York, N. Y.

The paper by Mr. Gibbs discussed the manufacture and erection of concrete telegraph poles along the line of the Pennsylvania across Hackensack meadows. Poles were rectangular section, pre-cast horizontally, and erected by bolting to timber grillage at base, which in turn was sunk in square excavation and bedded in concrete.

Concrete Fence Posts—W. J. TOWNE, Engineer of Maintenance, Chicago and Northwestern Railroad, Chicago, Ill.

Mr. Towne's paper on fence posts was read by Mr. Humphrey. This also described railroad methods of post construction, and opened up a general discussion of this subject at which many points were brought out.

The Making and Driving of Reinforced Concrete Piles Within Six Days—ROBERT A. CUMMINGS, Consulting Engineer, Pittsburgh, Pa.

Mr. Cummings' paper was read by title and will appear in abstract in a later issue.

Comparative Tests of the Strength of Concrete in the Laboratory and in the Field—RUDOLPH J. WIG, Assistant Engineer, Bureau of Standards, Washington, D. C.

The paper by Mr. Wig presented data on the variation of concretes made in the field and laboratory. Interesting results were presented.

Field Inspection and Tests of Materials for Reinforced Concrete—G. H. BAYLES, Engineer, New York Dock Company, New York, N. Y.

Unit Cost of Reinforced Concrete for Industrial Buildings—C. S. ALLEN, Lockwood, Greene and Company, Boston, Mass.

Notes on the Deformation in the Webs of Rectangular Concrete Beams—H. C. BERRY, Assistant Professor of Materials of Construction, University of Pennsylvania, Philadelphia, Pa.

The papers by Mr. Boyles, Mr. Allen and Mr. Berry were read by title. The paper by Mr. Allen appears on page 188 of this issue.

The Use of Cement for Protecting Steel Pipes Along the New York Aqueduct—ALFRED D. FLINN, Department Engineer, Board of Water Supply, New York, N. Y.

Mr. Flinn's paper describing the Catskill aqueduct work was read by Mr. Humphrey, and was illustrated by slides, an interesting review of a great work.*

Modern Methods of Manufacturing Concrete Products—ROBERT F. HAVLIK, Engineer, Ideal Concrete Machinery Company, South Bend, Ind.

Some interesting details of concrete block construction were discussed by Mr. Havlik, whose paper closed the Saturday morning session.

The Use of Concrete in the Fourth Avenue Subway, Brooklyn, N. Y.—FREDERICK C. NOBLE, Division Engineer, Public Service Commission, Brooklyn, N. Y.

*See Cement Age, January, 1912.

Mr. Noble's paper was ready by Mr. Humphrey. The work in the Brooklyn subway was described in detail in CEMENT AGE for June, 1911.

REINFORCED CONCRETE IN AGRICULTORE—W. A. COLLINGS, Engineer, Builders' Material Supply Co., Kansas City, Mo.

The paper by Mr. Collings described concrete on the farm, and urged closer relations between the National Association and the men who design and construct concrete for the farmer.

THE HANDLING OF CONCRETE IN THE CONSTRUCTION OF THE PANAMA CANAL—S. B. WILLIAMSON, Engineer, Pacific Division, Panama.

The illustrations in Mr. Williamson's paper were discussed informally as they were thrown on the screen. Mr. Williamson was not able to be present.

IRON PORTLAND CEMENT—A. E. WILLIAMS, Department of Ceramics, University of Illinois, Urbana, Ill.

THE PRESENT STATUS OF IRON PORTLAND CEMENTS—P. H. BATES, Chemist, Bureau of Standards, Pittsburgh, Pa.

IRON PORTLAND CEMENT—HERMAN E. BROWN, Chief Engineer, American Cement Engineering Co., New York, N. Y.

In the symposium on iron cement, the paper by Mr. Williams was read by title and the first paper was read by Mr. Bates, after which President Humphrey read the paper by Mr. Brown. The papers were interesting as showing the relation of the iron content in cement to its ability to withstand sea water attack. An abstract of these papers appears on page 194 of this issue.

The report of the resolutions committee closed the convention.

The new work forecasted in the resolutions is as follows:

A committee will be appointed to consider the form of all standard specifications or recommended practice issued by this Association with a view to securing uniformity so far as practicable.

A committee will be appointed to plan a comprehensive and systematic investigation of the aggregates used for concrete and to interest State Universities, Experiment Stations and other laboratories in carrying out the same.

The Committee on Nomenclature will so extend its work to include the Standardization of the size of drawings, the symbols used on same and the graphical representation of details.

The Committee on Cement Products will consider the suggestions and criticisms on building block specifications offered at this Convention, to confer with the Committee on Reinforced Concrete and Building Laws with a view to reconciling the recommendations of the two committees and to report revised specifications to the next convention.

A report will be submitted to the next Convention on standard specifications for fence posts.

THE ASSOCIATION STANDARDS OF PRACTICE: A word should be said here about the publications covering recommended practice which have been prepared by the Association, and a great many of which are now available. The standards are carefully worked out in committee and then submitted to the convention and gone over clause by clause. Concrete engineers, contractors and architects would find in these publications, which are all published in the annual proceedings, most valuable and practical suggestions covering the conduct of work.

Re-Rolled Rails for Concrete Reinforcement

Lewis N. Lukens, President of the Longmead Iron Co., Conshohocken, Pa., takes exception to statements made by some that re-rolled railway rails are not safe or suitable for reinforcement. In a communication to *Engineering News* he writes in part as follows:

No material is so carefully inspected, carefully analyzed, so uniform or so carefully rolled as railway rails. The subsequent re-heating and re-rolling, if properly done, can only improve the material. Every iron manufacturer knows that if it is not burnt, the more iron or steel is re-worked, the better its quality becomes.

A rail cannot be brittle; if so, it will not do duty as a rail. The recent talk about brittle rails means brittle under certain very trying conditions, and as a matter of course, the one rail, out of thousands of tons, that breaks under service is not re-rolled. The rails that have been re-rolled have stood the test for years under the most severe conditions, and the purchaser of re-rolled reinforcing bars is getting a material every bar of which has been tested. The purchaser of bars rolled directly from the billet is getting bars of which only samples can be tested. There may be a flaw in the next bar or billet to that one tested. It is a matter of common rumor, if not common knowledge, that the scabbed, piped and otherwise defective billets are used for rolling into reinforcing bars; also, in many cases, the crop ends from the ingot, rejected as not being good enough for a rail, are so rolled.

Government-Built Concrete Dwellings for New Zealand Workingmen

In accordance with an act passed in December, 1910, the government of New Zealand is now putting into operation a plan for the sale to workmen, in cash installments, of dwellings especially suitable to their use.

Workers' dwellings under the new act, the same as under the old, may be built of wood, concrete, or brick, but the total cost must not exceed £600 ($2,920). The department of labor has recommended to the workers that they choose houses of ferro-concrete, for although they cost somewhat more than wood (approximately $30 per dwelling), this extra cost is more than compensated for by the extra durability, the saving in cost of maintenance and insurance, and the fact that the dwellings are warmer, more weatherproof, and less sensitive generally to external influences.

The concrete dwellings present the best appearance and give the best satisfaction, especially as regards saving in fire insurance. In Wellington, which is located in a district subject to frequent earthquakes, wood and concrete construction are both considered safer than brick, but as the earthquake risk also carries with it an extra fire rate, the concrete dwellings appear more desirable than those of wood, and the fire insurance companies doing business there charge only 3s. 4d. (81 cents) premium on every £100 ($86.65) on concrete houses as against 8s. 9d. ($2.12) on wooden houses.

COSTS OF DIFFERENT TEST LOADS

IN a recent issue of the *Engineering Review* of Purdue University, C. H. Weitz discusses the comparative efficiency of different methods of testing.

The building ordinances in nearly every large city require that the reinforced concrete floor systems of all buildings erected within the city limits be tested for strength. This is done by applying a test load to two or more adjacent panels in one or more floors of the building. The test load is usually some multiple of the theoretical safe load. The Chicago ordinances require the superimposed test load to be equal to twice the live load plus the dead load. Previous to applying the load the distance from the under side of the slab to be tested to the top of the floor beneath is measured very accurately. When the load is in place this distance is again measured. The difference between the two measurements is the deflection. The maximum deflection allowed by the Chicago ordinances is 1/700 of the span.

A number of materials have been tried out for loading the floors; such as pig iron, rubble stone, and bags of cement, gravel or sand. Where cartage charges and wages are high, the cost of a single test, using any of the above materials, will run from $200 to as high as $700. The latter figure may look very high, but a little figuring will show that the amount is not excessive or unusual. In the first place two slabs, which measure 18 x 20 ft. each, live load 250 lbs. per sq. ft., it will require about 200 tons of material for the test load. Cartage on this material to and from the job will cost

Per ton	$1.00
Unloading and hoisting	1.50
Taking down and reloading	1.00
Total cost per ton	$3.50

This makes a total of $700 for handling the 200 tons of material and is a very low estimate of the cost where laborer's wages are $3 per day, hoisting engineers get $5.60 and teams cost $7 per day.

It was while casting about for some cheaper method for making these tests that the writer hit upon the use of torpedo sand in the bulk. Damp torpedo sand weighs about 110 lb. per cu. ft. as it is shoveled into a bin or pile. A 2-in. plank enclosure was built on the center line of columns, enclosing floor panels. The height of this enclosure in feet was just 9/10 of the hundreds of lb. per square foot of the test load. For instance, a test load of 400 lb. per sq. ft. requires a bin 3 ft. 7 in. high.

The sand can be loaded into wheelbarrows and hoisted on a brick hoist, or, more cheaply, in a concrete skip; or, still more cheaply, if conditions permit, by means of a bucket elevator. The sand should be hoisted first to the highest floor to be tested, thrown into the bin and leveled off even with the sides of the bin with a straightedge. The cost of hoisting the sand by the first method will run about 75 cts. per ton; by the second method 30 cts. per ton; and, by the third method 15 cts. per ton. These prices include placing the sand in the bin provided it is located within 30 ft. of the place where the sand is delivered by the hoisting apparatus. There is usually one or more of the above mentioned hoisting mechanisms available on the job, so that it is unnecessary to erect a hoist especially for testing purposes.

As soon as one floor is tested and the load is wanted on a lower floor, it is not necessary to lower the sand by means of a hoist or to carry it down a stairway as is the case when pig iron, rubble, or ballast in bags is used. Instead, all that is needed is to cut a small hole in the slab from beneath and let the sand run through. The hole can then be patched at slight expense.

When as many tests are made as is required the sand may be dropped down a stair or elevator shaft, through a window, or down a rubbish chute directly into wagons. However, there are usually a number of things remaining to be done, such as basement floors, sidewalks, etc., for which a quantity of torpedo sand is needed so that it is seldom necessary to remove any of the sand from the premises.

On a recent job about 150 tons of sand were hoisted by means of a bucket elevator to the third floor and spouted through a window on to the floor. This sand was then shoveled into a bin covering two panels to the required depth. The load was allowed to remain 24 hours for the city inspector to make his observations. A hole was then cut in the slab and the sand allowed to run down to the second floor where a bin had been prepared. After the test of the second floor the sand was dropped to the ground and was all used for cinder concrete and for the first floor which was laid directly on the ground.

The entire cost of these two tests which involved the handling of 150 tons of material three times, was slightly less than $50.

The Electrolytic Corrosive Theory

[*From Ferro-Concrete.*]

During the last year or so, a good deal of nonsense has been written on the problematical risk to ferro-concrete structures owing to electrolytic corrosion of the reinforcement. The avidity with which some engineers seize upon new-fangled theories to the detriment of ferro-concrete is only equalled by their conservative prejudice against well-established facts in favor of the same material. We have even known cases where electrolytic corrosion has been gravely pronounced to have occurred in the admitted absence of stray electric currents. The scientific observers who have demonstrated the reducing power of electricity under specially favorable conditions are reasonable beings who have no axe to grind, and do not condemn ferro-concrete as liable to deterioration, because they know that the special conditions favorable to electrolytic corrosion are absent in practical work. As an illustration, let us assume that the framework of a steel building could be slightly corroded by means of electric currents directly applied to the structure. In such a case there would be actual metallic connection throughout the entire system of steel work, and, in consequence, the whole of it would act as a conductor. But in the case of a ferro-concrete building or kindred structure the steel employed as reinforcement is not in metallic connection, being insulated everywhere by concrete, and therefore quite efficiently protected by non-conducting material. The simple-minded people who fear the electrolytic-corrosion bogey evidently do not know that in the only tests bearing upon the subject, the metal under examination is always directly connected with the positive and negative leads of the circuit, a condition never obtaining in actual practice. Moreover, while fears are openly expressed as to the risk of electrolysis in ferro-concrete structures, we hear nothing about the far greater risks to which riveted steel structures, especially the frame work of a steel-framed building, would be exposed if there were any actual reason for regarding electrolytic corrosion seriously in engineering and architectural practice.

A FIREPROOF AUTOMOBILE SALES AND REPAIR BUILDING

WITHIN the last few years a new automobile center has been forming in the vicinity of Twenty-third and Market streets, Philadelphia, and several automobile manufacturers and dealers have already erected buildings and located there. One of the most prominent of these buildings is that occupied by the Locomobile Company of America, on the south side of Market street, west of Twenty-third street, designed by Ballinger & Perrot, architects and engineers, Philadelphia.

This building is of fireproof construction throughout, and admirably adapted for the use for which it was intended. It has a frontage of

FIG. 1—A NEW BUILDING IN THE AUTIMOBILE CENTER, PHILADELPHIA.
Structural concrete floor and frame, terra cotta facing.

78 ft. on Market street and extends in depth 106 ft. to Ludlow street, upon which it has the same frontage. It is four stories in height on Market street, and five stories in height on Ludlow street.

The ground story, which is at the Ludlow street level, is used for garage purposes, and is provided with accessories such as gasoline and oil stores and compressed air. In this story are also located the steam heating boilers, which, however, are cut off by fire walls from the remainder of the ground floor, access to the room in which they are located being obtained only by passing to the outer air as a provision against danger from gasoline explosions.

In the first story the main entrance is on Market street and contains a show room in front, with offices and waiting room in the rear. This show room is elaborately fitted up with quartered oak panels on the side walls and terrazzo floors and marble mosaic borders. The front of the second story is used as an additional show room and the rear as a stock room, with a dumbwaiter communicating with all stories. The upper stories are used for machine shop, painting and repair purposes.

The Market street front of the building is entirely of light terra cotta and makes an imposing appearance. The window space both on this front and in the rear of the building is as large as possible, making the interior in each story unusually well lighted. The side and rear walls are of red brick.

A feature of special interest in connection with the construction of the building is the manner of supporting the columns adjacent to the party lines and main street front, by means of which the column loads are transferred to a bearing inside the property lines. This is accomplished by means of what is called a "combined footing" of tee section, each supporting a wall column at one end and an interior column at the other. The tension in the beam is thus at the top and the compression at the bottom. The beams have a total depth, including "tee," of 6 ft. 6 in., the "tee" being 24 in. high, and 5 ft. 8 in. wide, the stem of the beam being 3 ft. 8 in. wide. Each beam is reinforced with eighteen 1¼ in. square twisted bars, nine of which are bent down toward the compression side of the beam near the ends, the remaining nine bars running straight through. Stirrups of ⅜-in. rods are placed at suitable intervals throughout. These beam footings have a total length of 28 ft. 9½ in., and the distance between center to center of wall columns and interior columns is 26 ft. 1¼ in.

The columns, girders, beams and floor and roof slabs are of reinforced concrete construction. There are two rows of columns, extending from front to back, dividing the building into three bays, 25 ft. wide. These columns have structural steel cores in the shape of four-pointed star, and are made round, so that they occupy a comparatively small space. The typical floor girders are 12 in. wide and 26 in. deep, reinforced with six 1⅛ in. square twisted bars, and have a span of 21 ft. The typical floor beams are 8 in. wide and 18 in. deep, reinforced with four 1in. square twisted bars, and have a span of 25 ft. The floor slabs are 5 in. thick, and have an additional wearing surface on top of cement, wood, or terrazzo, as the case may be, in the several stories. Reinforcing steel to meet the specifications of the Association of

American Steel Manufacturers and Portland cement to meet the specifications of the American Society for Testing Materials were used. The floor slabs were designed for a concentrated wheel load of 2,500 lb. per sq. ft.

The roof slab is 2½ in. thick and is covered with felt and slag roofing. Reinforced concrete skylights provide additional lighting surface in the upper stories.

The building is heated by a low pressure gravity steam heating system, using all direct radiation except in show room, where indirect stacks are installed.

The building is electrically lighted throughout, with a large electric sign at the top, some gas outlets being installed for emergency use. The show room is lighted by means of numerous single tungsten units, placed on the ceiling slab and so arranged that while they illuminate the room perfectly, the source of light is not visible when entering the building from the main entrance, or looking in the show room windows from the street.

A moderate speed automobile elevator of 12,000 lb. capacity is provided, which runs to all stories.

The gasoline storage system consists of a tank buried under the floor of the building, supplying a pump located in a fireproof room, from which the gasoline is pumped into a portable tank on wheels, from which the cars are filled. Tanks for the storage of oil and grease are also located in this fireproof room.

Forms Required

The number of sets of forms to make up for any building varies with the speed of construction required, weather conditions, and shape of building. On an average 1½ sets of forms is a fair allowance. With this number says *Building Age*, erection on the floor above can begin while the concrete below is green, so that in good weather a story can be built in a week or ten days.

Some large building contractors have adopted the use of only one set of forms in a building, whether it be 2 stories or 10 stories high, with additional lumber for girder bottoms and supports that must be left in.

A building of large floor area may be built in sections, setting up, say, one-half of a floor area at a time, so that forms for only about three fourths of one floor are needed with extra beam bottoms and posts. On the other hand, if the building is small in area and high, two sets of forms may be needed in order to go fast enough.

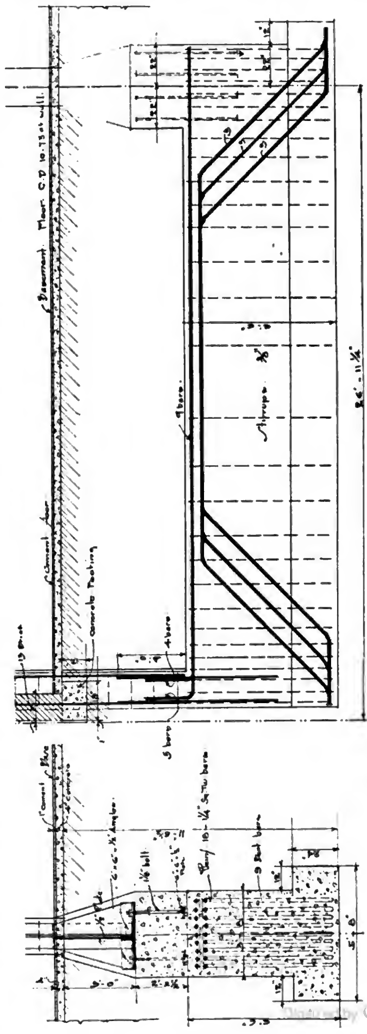

FIG. 2—SECTION AND ELEVATION OF REINFORCED CONCRETE FOOTINGS.
This is cantilevered so that wall columns are carried entirely within property line.

UNIT COSTS OF REINFORCED CONCRETE FOR INDUSTRIAL BUILDINGS

By Chester S. Allen*

UNIT costs are in a way like strong drink, harmless where used with judgment and prudence, but likely to bring remorse and anguish where employed promiscuously. Rare and talented indeed is the man who possesses the experience, judgment and intuitive sense to know when, where, and how to properly modify any tables or statements of unit costs to meet the peculiar conditions of each individual case. While the figures given in this paper are all taken from structures erected during the past two years under the writer's supervision, the wide range of territory, local conditions, and different seasons of the year under which the various pieces of work have been executed is so great as to render the information given of value only in a very general way.

As a general proposition we have found that reinforced concrete is the lowest priced fireproof material suitable for factory construction and while it is true that its first cost will generally run from 5 per cent to 20 per cent higher than first class mill construction, we have recently had several instances where, with lumber at a high price, reinforced concrete has worked out cheaper than brick and timber. It is especially adapted to heavy construction and for heavy loads of 200 lb. per sq. ft. and over where the spans are 18 to 20 ft. centers not even timber can compete with it.

The unit cost of projected or completed buildings are commonly figured either as so much per cu. ft. or so much per sq. ft. of area occupied. Table 1 gives the unit costs both on the square foot and the cubic foot basis, together with a general description of a number of reinforced concrete industrial buildings of different types erected during the past two years. It will be seen from an examination of this table that the average cost per square foot of these buildings, excluding the one-story structures, was $1.12, while the average cost per cubic foot was 8.7 cts. The one-story structures had reinforced concrete sawtooth roofs and the average cost per square foot was $1.77, while 8.5 cts. was the average cost per cubic foot. The above costs are for the finished buildings including plumbing, but do not embody heating, lighting, elevators, sprinklers and power equipment. The cost per square foot of floor area was obtained by dividing the cost of the building by the total number of square feet of floor area exclusive of roof area but including basement floors and the cost per cubic foot by dividing the cubical contents into the cost of the structure.

While no coal pockets are included in Table 1, it has been our experience that above 3,000 tons capacity reinforced concrete elevator coal pockets cost from $5.50 to $7.50 per ton of capacity. Standpipes, exclusive of the foundations, average from 2½ to 3 cts. per gallon of capacity.

On much of the reinforced concrete work which has been done under our supervision it has been possible owing to the contract being either on a percentage or cost plus fixed sum basis for us to obtain quite accurate and comprehensive cost data. This data, of course, is only of particular value where all the local color of each specific case is known, but the average results are at least interesting.

The average unit cost of the 1:2:4 concrete in the floors including the beams, girders, and slabs was $6.10 per cu. yd. and for the columns $6.70 per cu. yd. Where 1:1½:3 mixture was used for the columns the average cost was $7.60 per cu. yd. This cost was made up of the items of cement, sand, stone or gravel, labor and plant. The cement, of course, varied greatly with the demand, but the average net cost was $1.35 per bbl. including 3 cts. for tests. The sand averaged 80 cts. per cu. yd. and the crushed stone $1.25 per cu. yd. The cost of labor of unloading the materials and mixing and placing the concrete varied from 65 cts. to $2.90 per cu. yd. The cost of plant consisting of freight, depreciation or rental of mixing and hoisting towers, erection of same, power and coal, and losses and waste on the small tools ranged from 50 cts. to $1.50 per cu. yd. of concrete placed.

Next to the proper design of the structural features of a concrete building the economical design of the form work is of paramount importance. The truth of this statement is borne out by the fact that on the average job the cost of the forms amounts to about one-third the cost of the entire structure. On the buildings under consideration the average cost of the forms for the floors including beams, girders, and slabs was 10 cts. per square foot and for the columns 13 cts. per square foot. The lowest cost was in a building of the so-called "mushroom" or flat slab type of construction where by the intelligent use of corrugated iron for the slab forms the cost of the floor forms including wall beams was 7 cts. per square foot and the highest cost was for an artistic but not elaborate overhanging cornice on a twelve-story building which was 32 cts. per square foot. This last item rather forcibly demonstrates that any attempt at architectural development is very apt to be a costly proposition.

The cost of the labor of making, erecting and stripping the forms varied according to the price of lumber, design of the structure, method of forming, character of the supervision and the skill of the workmen from 4¾ to 12 cts. per square foot. The cost of lumber, nails, and oil divided by the square feet of forms averaged from 2¼ to 4½ cts. per square foot.

*Presented at the Eighth Annual Convention of the National Association of Cement Users, March 11-16, 1912, Kansas City, Mo.
†Lockwood, Greene & Co., Boston, Mass.

The cost of bending and placing the reinforcing steel including the necessary wire averaged $10 per ton, the range being from $5.75 per ton to $17.20 per ton.

Granolithic floor finish, 1¼-in. thick, when laid before the concrete below it had set so as to form one homogeneous slab cost on the average of 4½ cts. per square foot. When put on after the rough concrete slab the cost averaged 7 cts. per square foot.

Inasmuch as the only economical design of a reinforced concrete structure is one which closely resembles that of the steel skeleton type, the relative cost of the various materials commonly used for curtain walls under the windows may be of interest. The writer has used brick, vitrified tile, concrete blocks, cast concrete slabs and solid concrete walls for this purpose.

The most common type of curtain wall has been either on 8-in. or 12-in. brick wall resting on the concrete wall beam. The average cost of these walls has been 45 cts. per square foot. There is practically no difference in cost between the 8-in. and the 12-in. brick curtain wall as the saving in material is offset by the great amount of extra labor in culling and laying the thinner wall.

An excellent and inexpensive spandrel wall is constructed by using 8-in. by 12-in. by 18-in. vitrified tile. This is a non-absorbent wall and when properly laid in cement mortar makes a tight weather proof curtain wall. The cost of this wall averages about 25 cts. per square foot. If the tile is plastered both sides the cost is about 38 cts. per square foot.

Where 8-in. concrete curtain walls were cast in place after skeleton frame was completed the average cost was 40 cts. per square foot and when poured simultaneously with the columns 48 cts. per square foot. Four-inch cast concrete slabs cost about 35 cts. per square foot.

While concrete blocks make a very cheap and light curtain wall, the price being about the same as for the 8-in. tile, the writer's experience with them has been rather unfortunate on account of their porosity.

Where the location of the buildings have demanded special treatment of the exposed surfaces we have generally specified rubbing with a block of carborundum. The average cost of this work has been 4 cts. per sq. ft. In two instances portions of the structure have been bush-hammered with a resulting average cost of 7 cts. per sq. ft.

Concrete piles were used on the foundation of several of the buildings and the average cost of the piles was $1.15 per lin. ft.

The most common methods of waterproofing concrete structures are by the introduction of foreign ingredients into the concrete, by the application of a compound to the concrete surface, by the use of paper or felt waterproofing and by accurately grading and proportioning the aggregate and the cement.

Where an addition of hydrated lime in the proportion of 10 per cent to the weight of the cement has been used the added cost to a cubic yard of 1:2:4 concrete has been 50 cts. Mortars made with patented cement compounds have cost from 25 to 35 cts. per sq. ft. of surface covered. On horizontal or inclined surfaces we have sometimes used a granolithic surface of rich mortar of Portland cement and sand, or Portland cement and screenings in the proportions of 1:1 laid at the same time as the base and troweled as in side wall construction. The cost of this work has been about 5 cts. per sq. ft.

Taken as a whole, the lowest possible cost on a reinforced concrete building can be obtained only by a careful study of each particular case to determine the cheapest type of construction and most economical spacing of columns. As a general proposition we have found that for light loads with ordinary beam and girder construction the most economical spacing of columns has been 18 ft. each way and for flat slab construction 20 ft. each way. For heavy loads such as 300 lb. per sq. ft. and over, it has been our experience that the cheapest column spacing for beam and girder construction is 15 ft. by 15 ft. and for flat slab construction 17 ft. by 17 ft. In arriving at the most economical layout it is always well to bear in mind that the construction which allows the greatest simplicity of form units together with the maximum number of repetitions of same is invariably the one that will work out cheapest in the end. The fact that the actual amount of concrete or steel required for a certain floor construction is less than that required in another by no means implies that this is actually the cheapest floor construction, as the unit labor of the form work may easily have been increased out of a proportion.

TABLE I. UNIT COSTS OF CONCRETE BUILDINGS.

Type of Building.	Dimensions.	No. stories.	Story height.	Live load lbs. per sq. ft.	Type of construction.	Col. spacing	Total cost. Per sq. ft.	Total cost. Per cu. ft.
Machine shop....	120'x50'	4	12' 0"	150	Beam	10' 0"x24' 0"	$1.17	$0.09
Cotton mill......	550'x129'	2	16' 0"	75	Beam	10' 8"x25' 0"	.98	0.07
		4	12' 6"	150	Flat slab	17' 0"x20' 0"	1.09	0.077
Weaving mill....	140'x60'	5	12' 6"	150	Flat slab	17' 6"x20' 0"	1.50	0.12
Knitting mill....	220'x75'	2	14' 0"	125	Beam and girder....	22' 0"x25' 0"	1.09	0.073
Factory	223'x56'	2	16' 0"	300 &	Beam and girder....	18' 6"x18' 6"	1.56	0.10
				1000	Sawtooth skylight..	13' 0"x21' 4"	1.79	0.07
Weave shed......	341'x231'	1		125	Sawtooth skylight..	20' 0"x20' 0"	1.75	0.10
Machine shop....	220'x100'	1			Flat slab...........	18' 0"x20' 0"	1.15	0.07
Store house......	181'x56'	4	14' 6"	150	Beam and girder....	19' 3"x {19' 0" / 25' 0"}	0.85	0.071
Store house......	580'x109'	10	12' 0"	250				
Store house......	256'x100'	12	8' 0"	150	Flat slab...........	16' 0"x16' 8"	1.04	.12

ESTIMATING STANDARDS AND THE QUANTITY SURVEYOR

THE report of the Committee on Measuring Concrete of the National Association of Cement Users has a direct relation to the question of quantity surveying which has been discussed at some length in these columns. The establishment of standard practice in estimating concrete would go far toward making possible the preparation of a professional quantity estimate for all bidders, and eliminate many present unsatisfactory conditions. Following is the report of the committee:

The committee submits suggestive rules for the measurement of concrete work. Especial attention is called to the classification as separate items of concrete, forms, reinforcement and surface finish. It is realized that, especially in case of forms, a departure from the present methods of measuring units is recommended, but after careful consideration the committee feels convinced that the present method of including, in measurement of concrete, forms and finish, and sometimes reinforcement, is fundamentally wrong and should be altered.

A few instances may be cited to make this point clear. Assume a contract for a building with unit prices per cubic foot for concrete in floors, columns and foundations, the said units to include the cost of forms and granolithic finish. If the engineer decides to reduce the thickness of the floor slab from 5 to 4 in., the contractor must put in just as much work on forms, but is paid for only 80 per cent of what he estimated on. If the building be increased from two stories to three stories in height, floors finished in granolithic, there will be twice as many floors to finish with granolithic than estimated for. Or vice versa, supposing a wall 8 in. thick is increased to 12 in., the owner must pay for 50 per cent more forms and surface finish than before, although the amount put in is the same.

Such cases are typical of the uncertainties of the present system of letting and taking contracts for concrete work at an inclusive unit price per cubic foot, and the committee feels confident that the rules suggested, if adopted, will be of real value to the community, eliminating such uncertainties and inequalities.

In other respects the committee has endeavored to conform as far as possible to general practice and desires to makes this standard.

The following notes and explanations cover the various details of the proposed rules.

CONCRETE. (*a*) *Monolithic Concrete*.—The rule stating that concrete in different parts of the building or structure shall be measured and described according to the cost of labor in placing, would indicate that there should be separate measurements appearing in the bill of quantities for

Concrete in footings; columns; floors, beams and girders; pavings; basement walls; curtain walls and partitions; and so on according to the nature of the work.

Concrete in mass foundations; abutments; arch ribs; spandrel walls; bridge floors and beams; parapet walls and cornices; and so on according to the nature of the work.

In event of any of these items, such as columns, being of different mixture on different floors, these also would be measured separately.

(*b*) *Structural Cast Concrete*.—The committee finds that structural cast concrete, the use of which is growing rapidly, is of an entirely different nature to monolithic concrete, and it has been endeavored to treat this part of the subject in a similar way to which structural steel is measured and estimated. It is not recommended, therefore, that forms be measured separately, but that erection should be separate from making, and the unit of weight suggested to be the correct unit for measuring erection, rather than the unit of volume.

(*c*) *Trim and Ornamental Cast Concrete*.—Cast stone trim and ornamental work is more nearly akin to cut stone work and the committee has followed the custom of the cast stone trade and based the proposed rules on those of stone masons, viz.: To measure the smallest cube out of which a piece can be taken for any piece of trim, instead of measuring the net volume of the finished block. Surfacing is generally done in the molds and therefore should not be separated. Reinforcement is a very small part of the cost and for that reason is not separated.

As the unit of erection of the stone masons is the same as the unit by which the stone is supplied, the committee does not suggest separation of erection from making.

FORMS.—After careful consideration the committee feels that the square feet of area of the surface supported is the correct unit for the measurement of forms. In their judgment the item which should be measured and paid for is the operation of supporting the plastic concrete until it has set. This item is practically an item of labor, although material enters into it.

It is the practice of some firms to estimate forms by the amount of lumber used, but this is not a correct unit to measure, not only on the theoretical ground stated above, but on the practical ground that no two contractors would use the same amount of lumber in erecting a piece of form work. If lumber on unit price contracts were measured and paid for by the board foot there would be an incentive to a contractor to use more lumber than was necessary to support the load. On the other hand the square foot measurement does not alter and is easily and quickly measured, and further, even those who estimate by the board foot have to determine the number of square feet to be supported before computing the number of board feet required in the building.

In the measurement of floor forms the sides of beams are added to the measurement of under side of slabs and beams, although some contractors take a flat measurement of floor surface. The latter method would work out unjustly in the case of a change being made in the depth of the beams, such change working to the detriment of either the owner or the contractor, while if the method the committee recommend is adopted such a change would adjust itself.

Some discussion may be raised on the omission of any allowance for angle fillets to columns and girders, but the committee realize that such items are a very small part of the cost of forms, and it is not a usual practice on the part of contractors to estimate them separately. They believe that to measure angle fillets by the lineal foot as has been suggested would prove a possible source of misunderstanding in the carrying out of a contract.

The separation of forms as to floors, columns, footings, etc., follow the lines laid down for separation of concrete items.

The committee append specimen bill of quantities on a building and bridge measured according to the proposed rules. A careful study of these will indicate the method in which they would be applied.

ESTIMATING STANDARDS AND THE QUANTITY SURVEYOR

Proposed Rules for the measurement of Concrete Construction.

The following divisions are recognized as separate and distinct items in concrete construction:

1. Concrete.
   - (*a*) Monolithic.
   - (*b*) Structural Cast Concrete.
   - (*c*) Cast Concrete Trim and Ornamental Work.
   - (*d*) Sidewalks.
2. Forms.
3. Reinforcement.
4. Surface Finish.

The following general rules shall govern the measurement of the above items, with exceptions where specifically noted:

(*a*) All work shall be measured net as fixed or placed in the structure.

(*b*) In no case shall non-existent materials be measured to cover extra labor.

(*c*) No allowance shall be made for waste, voids or cutting.

1. CONCRETE.

(a) Monolithic Concrete:

The unit of measure for all concrete shall be the cubic foot.

All concrete shall be measured net as placed or poured in the structure or building.

All openings and voids in concrete shall be deducted with the following exceptions:

(a) No deduction shall be made for reinforcement bars, I-beams, bolts, etc., embedded in concrete, except where they have a sectional area of more than 1 sq. ft.

(b) No deduction shall be made for pipes or holes in concrete having a sectional area of less than 1 sq. ft.

(c) No deduction shall be made for chamfered, beveled, or splayed angles to columns, beams, and other work, except where such chamfer, bevel or splay is more than 4 in. wide measured diagonally across the surface.

Each class of concrete having a different proportion of cement, sand or aggregate shall be measured and described separately in accordance with the accessibility and location or purpose of the work.

Concrete in different members of a building or structure shall be measured and described separately according to the amount of labor required in pouring.

Concrete with large stones and rocks embedded in it (cyclopean masonry) shall be measured as one item and described according to the mixture and the percentage of rock.

In no case shall the measurement of concrete be held to include the forms.

In no case shall an excess measurement of concrete be taken to pay for the cost of forms or extra labor in placing.

Concrete in stairs shall be measured by the cubic foot and shall include surface finish when the mixture is the same throughout.

(b) Structural Cast Concrete:

The term structural cast concrete is taken to include beam and slab construction* by the various unit systems now in vogue.

The unit of measurement shall be the cubic foot and this shall be measured net as provided for monolithic concrete.

The various members shall be measured on the ground before erection.

No measurement shall be taken of forms.

Reinforcement shall be measured separately as provided under Reinforcement.

The unit of measure for erection shall be the pound weight† of the finished member.

Cast concrete with crushed stone or gravel aggregate shall be assumed to weigh 150 lbs. per cu. ft.

(c) Cast Concrete Trim and Ornamental Work:

Cast concrete building trim shall be measured by the cubic foot but the measurement shall be the smallest cube* which will contain the piece measured and not the actual net volume of the piece.

No allowance shall be made for forms.

Mitre blocks for cornices, etc., shall be measured separately from straight molded work.

Circular work shall be measured separately from other work.

Vases, seats, pedestals, balusters, and other similar items shall be taken by number and description.

No allowance shall be made for reinforcement.

No allowance shall be made for surface finish.

(d) Sidewalks:†

Sidewalks shall be measured by the square foot.

The one measurement shall include concrete finish, lining in squares, and cinder or stone foundation.

Curbs and curb and gutter work shall be measured by the lineal foot and separated according to character and size, and shall include foundations, forms, finish and cost of special tools if any.

In measuring curbs the full height, width or thicknes shall be taken.

The measurement of sidewalks shall be taken the full width.

Circular corners and curbs and gutters shall be measured separately by number, stating radius and length measured on the curve.

Vault lights shall be measured by the square foot, the measurement deemed to include glass, forms, steel and finish. Beams under vault lights shall be measured by the lineal foot. In measuring vault lights the measurement shall go at least 4 in. beyond the outside line of the glass in each direction.

2. FORMS.

The unit of measure for form work shall be the square foot of actual area of the surface of the concrete in contact with the forms or false work.

Forms shall in every case be measured and described as a separate item, and in no case shall the measurement of concrete be taken to include forms.

No deduction shall be made in the measurement of surface of concrete supported by forms because of forms being taken down and re-used two or three times in the course of construction.

The unit price for superficial measurement of forms shall be deemed to include the cost of struts, posts, bracing, and bolts, wire ties, oiling and cleaning and repairing forms.

No allowance shall be made for angle fillets or bevels to beams and columns, etc., but curved moldings shall be measured and described separately as hereinafter provided.

No deduction in measurement of forms shall be made for openings having an area of less than twenty-five (25) sq. ft.

No deduction shall be made in floor forms for heads of columns.

No deduction shall be made in column and girder forms for ends of girders, cross beams, etc.

No allowance shall be made for pockets in column forms for clearing out rubbish.

The measurement of column forms shall be the sum of the girth of the sides or circumference multiplied by the height from the floor to under side of floor slab above.

The measurement of beam forms shall be the net length between columns multiplied by the sum of the breadth and twice the depth below the slab, except for wall beams and other beams at an edge of floor, which shall have the thickness of the floor slab added to twice the depth.

Wall forms shall be measured for both sides of concrete wall when forms are required for both sides.

Allowances shall be made by number for pockets left for future beams.

Forms to octagonal, hexagonal, and circular columns shall be measured and described separately from forms to square columns.

Caps and bases to columns and other ornamental work shall be measured by number and fully described over all dimensions.

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*This also includes, of course, columns, lintels, panels, and all pre-cast structural work.—Editors.

†Not necessarily meant that all weight shall be indicated in pounds. One hundred weight on small work, and tons on large work might well be used.—Editors.

*By "cube" is evidently meant the rectangular solid block.—Editors

†It might be well to add "Pavements" to this classification.—Editors.

The curved moldings in form work shall be measured by the linear foot.

Forms to circular work shall always be measured separately from forms to straight work.

No measurement or allowance shall be made in slabs or beams for construction joints to stop the day's concreting.

Construction joints or expansion joints to dams and other large masses of concrete shall, however, be measured.

Forms to cornices shall be measured by the lineal foot, and the girth stated. (The term girth shall be taken to mean the total width of all curved and straight surfaces touched by the forms). Plain forms to back of cornice to be measured separately.

Forms to different parts of structural building shall be measured and described separately according to their position in the building and cost and character of the work involved.

Forms to window sills, copings, and similar work *in situ* shall be measured by the lineal foot.

Forms to the upper side of sloping slabs such as saw tooth roofs shall be measured whenever the slope of such slab with the horizontal exceeds an angle of 25 degrees.

Forms to the under side of stairs shall be measured by the superficial foot.

Forms to the front edge of the stairs shall be measured by the lineal foot.

Forms to the ends of steps shall be measured by number of risers.

3. Steel Reinforcement.

The unit of measure of steel reinforcement shall be the pound weight.

Steel rods for reinforcement shall be measured the net weight placed in the building.

The weight shall be calculated on the basis of a square bar 1-in. by 1- in. by 12-in. weighing 3.4 lbs.

No allowance shall be made for rolling margin.

No allowance shall be made for cutting or waste.

No allowance shall be made for wire ties, spacers, etc.

In estimating reinforcement the bars shall be measured by the lineal foot as laid. All laps shall be allowed for.

The bars of each different size shall be measured and described separately, as also straight bars, bent bars, stumps and hooping.

Pipe sleeves, turnbuckles, clamps, threaded ends, nuts, and other forms of mechanical bond shall be measured separately by number and size and allowed for in addition.

Wire cloth, expanded metal, folded fabric and other steel fabrics sold in sheets or rolls, shall be measured and described by the square foot. The size of mesh steel in tension and weight per square foot shall be stated. No allowance shall be made for waste, cutting, etc.

Deformed bars shall be measured separately from plain.

4. Surface Finish.

The unit of measure for finish of concrete surfaces shall be the square foot. Finish shall always be measured and described separately.

No measurement or allowance shall be made for going over concrete work after removing of forms and patching up voids and stone pockets, removing fins, etc.

Granolithic finish shall be measured by the square foot and shall include all labor and materials for the specified thickness.

Finish laid integral with the slab shall be measured separately from finish laid after slab has set.

No allowance shall be made for protection of finish with sawdust, sand or testing.

Grooved surfaces, gutters, curbs, etc., shall be measured separately from plain granolithic and shall be measured by the square foot to lineal foot as the case may require.

The following shall be measured by the square foot:

Cement wash (state how many coats).
Rubbing with carborundum.
Scrubbing with wire brushes.
Tooling.
Picking.
Plastering, etc.

Appendix A—Bill of Quantities for Bridge.

Concrete. 1:3:6 cyclopean masonry with 30 per cent rock in foundations	2,000	cu. yds.
" 1:3:6 in abutments	1,500	"
" 1:3:6 in piers	1,000	"
" 1:2½:5 in abutments (upper part)	500	"
" 1:2½:5 in pier (upper part)	500	"
" 1:2:4 in arch ribs	1,200	"
" 1:2:4 in columns above same	150	"
" 1:2:4 in spandrel walls and wing walls	250	"
" 1:2:4 in bridge floor and beams	600	"
" 1:2:4 in parapet wall	100	"
Forms to abutments (below finished grade	12,000	sq. ft.
" to abutments (above finished grade	6,000	"
" to piers (below finished grade)	10,000	"
" to piers (above finished grade)	8,000	"
" to arch ribs	15,500	"
" to columns	1,200	"
" to spandrel walls and wing walls	5,000	"
" to bridge floor and beams	12,000	"
" to parapet wall	2,500	"
" to coping of same	300	lin. ft.
Steel reinforcement plain round bars, 1¼ in.	30,000	lbs.
1 in.	50,000	"
¾ in.	75,500	"
½ in.	12,000	"
⅜ in.	10,000	"
Crandalled finish on piers and parapet	2,500	"
Rubbed finish on arch ribs (face and soffits)	4,000	"
Granolithic finish 1 in. thick to sidewalks of bridge floor laid integral with slab	2,000	sq. ft.
Granolithic finish to curb and gutter of same	300	lin. ft.
Sidewalk to approaches with 4 in. base 1:2½:5 and 1 in. top and includes cinder foundation	300	sq. ft.
Curb and gutter to last, curb 10 in. high, gutter 12 in. wide, including forms and finish done in one operation	200	lin. ft.
Extra for rounded corners to same 3 ft. girth 4 in number.		
Cast concrete balusters 8 in. by 8 in. by 2 ft. high, including forms and steel and setting in place 50 in number		
Cast concrete coping to same 18 in. by 9 in. with molded edges, including forms, steel, finish and setting in place	200	lin. ft.

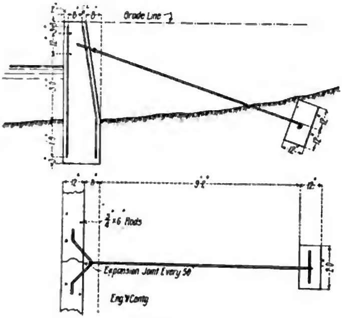
Bill of Quantities for Building.

Concrete. 1:2½:5 in footings	500	cu. yds.
" " basement walls ...	220	"
" " base to paving ...	90	"
" 1:2:4 in floors and beams.	2,100	"
" " columns	650	"
" " partition and curtain walls	200	"
" " walls, roof of pent house	30	"
" " cornice and parapet.	100	"
" 1:1½:3 in columns	110	"
Cinder concrete 1:3:6 in fill between screeds (2 in. thick) ..	225	"
Forms to footings	1,000	sq. ft.
" to floor slabs and beams	15,500	"
" to columns	3,500	"
" curtain walls and partitions ..	3,350	"
" to pent house	900	"
" to basement walls	3,000	"
" parapet and back of cornice ..	1,200	"
" face of cornice 36 in. girth ..	400	lin. ft.
Steel reinforcement of plain round bars, including cutting, wiring, placing		
1¼ in. diameter	5,000	lbs.
1 in. "	7,000	"
¾ in. "	12,000	"
½ in. "	24,500	"

Steel reinforcement of plain round bars, including cutting, wiring, placing, but also including bending		
1¼ in. diameter.......	8,000	lbs.
1 in. "	17,800	"
½ in. "	28,500	"
⅜ in. "	6,000	"
Steel reinforcement of square twisted bars, including cutting, wiring and placing....		
1 in. by 1 in.......	3,000	"
⅞ in. by ⅞ in.......	8,000	"
½ in. by ½ in.......	4,000	"
Granolithic finish 1 in. thick laid integral with paving....	5,000	sq. ft.
Granolithic finish 1 in. thick laid on floors after concrete has set	15,000	"
Granolithic finish on cornice and parapet	600	"
Granolithic finish on window sills...	1,200	"
Picked face to concrete surface......	2,000	"
Rubbed face and cement wash one coat on concrete surface	3,000	"

RETAINING WALL WITH REAR ANCHORAGE

This wall, built for the State of Ohio, is described by R. A. Boothe, constructing engineer, in *Engineering and Contracting.* It was built in two sections of 400 and 500 ft. each. The wall was built around an island, about 10 ft. from the bank. The



PLAN AND, ELEVATION OF WALL.

space between the bank and wall was afterwards filled up with dirt taken out of the beach about 50 ft. from the face of the wall. Normally the water in the lake is about 18 ins. below the top of the wall, but to do this work the lake was drained down until it left a beach in front of the wall about 200 ft. wide.

When the walls were built two openings 10 ft. wide were left in each section so that the dirt could be hauled through. The backfill was a sandy clay and amounted to about 2,000 cu. yds. It was ploughed and hauled in slip scrapers. The average haul was 150 ft. and cost 21 cts. per cubic yard including plowing, teams being paid 50 cts. per hour.

The concrete plant consisted of a 1-3 cu. yd. mixer mounted on skids. The material was hauled about 1 mile from the railroad and dumped in piles near the mixer; from there it was wheeled up runways to the mixer which was fitted with a batch hopper, and from the mixer it was wheeled to the job and placed. As two set-ups of the plant were made, one in the center of each section, the longest haul was about 125 ft.

In placing the concrete the trench was dug for the foundations and the concrete and steel placed, then the forms were placed. These were built in sheets 12 ft. 6 ins. long and 5 ft. high, and were made of ⅞-in. tongue and grooved stuff with 2 x 4 in. uprights on 2-ft. centers. The forms were held together with wiring and two rows of 4 x 4 in. waling on each side. The concrete was poured in 50-ft. sections, and forms enough were built for two sections, so that while one section was being poured the carpenters could be working on the next. As the forms were wrecked on the second day after pouring it was necessary to put the laborers to digging foundation or filling it ahead on every third day until forms could be built.

GOOD ADVICE TO CONCRETE SPECIALISTS

Having in mind the honest and thorough workmanship that usually attends construction in England, *Concrete and Constructional Engineering* gives the following good advice to those about to make a specialty of concrete work, an admonition that could be followed with profit in other countries:

"The great thing for specialist contractors to strive against is the insidious manner in which by the growth of their businesses they may devolve from good to inferior and bad work. It is hard to set oneself against taking on work when it is offered, and to continue to have a small output and make a regular profit year after year when it appears so easy to increase; but that will be the most effectual procedure in the end. They should make up their minds to carry out only a certain amount of work which they have the staff capable of doing, and see that they get proper prices. If they do that they will not need to complain of excessive cutting of prices, and they will be able to go on in a profitable business, whereas the opposite road leads to continual striving to increase the output and cheapen the production so as to enable undercutting. This tends in a short while surely to reduce the profits for everyone, and to bring the rates down to such a point that few can do good work and make a profit. It has been proved in general contracting work that such a policy is a foolish one, because a few firms are quite unable in the building and engineering industries to freeze out their rivals and secure a monopoly; a combine is quite impossible in these trades. Therefore, everyone in the end loses by such undercutting. If the specialist contractors are wise they will be careful not to undercut, but to maintain a fair price for good work, or refuse to do work too cheaply with its natural degeneration into shoddy work. In the end the public will appreciate that good work must be paid for, and, fortunately, the engineering and architectural professions are pretty well aware of it; at any rate, the leading members know what is good work, and they are prepared to back the firms that do it."

Where form lumber is to be taken apart and rebuilt or used for other purposes, very light nailing is of great advantage.

THE PRESENT STATUS OF IRON ORE CEMENTS

AT the recent convention of the National Association of Cement Users, several papers were presented on this subject. The industry as a whole was treated in a very interesting paper by P. H. Bates chemist, Bureau of Standards, Pittsburg, Pa. It was also especially considered in a paper by H. E. Brown, chief engineer, American Cement Engineering Company, who wrote on "Marine or Iron Ore Cements," and also by A. E. Williams, of the University of Illinois, whose paper was entitled "Iron Portland Cement."

In order to clear the matter of any misunderstanding it must be understood that there are two kinds of cement in which iron ore, or iron slag, are present and are recognized under technical names. Iron ore cement is known in Germany as "Erz" cement, while a mixture of slag and Portland cement in Germany is known as "Eisen" Portland cement, and both materials are recognized in the industry in that country though unfamiliar to us here. It is only recently that attention has been called to the high lime content of Portland which, by some experts, is alleged to be due to the ease of manufacture and the ease of handling by the consumer, and various means of overcoming this by the addition of trass, tufa, slag and other ingredients which would be impossible were it not considered that normal Portland cement is in many cases overlimed. Alumina also has been attacked by various engineers and scientists as a constituent of Portland cement, the allegation being that in salt water it combines with the sulphuric anhydride, freeing the lime in the process of setting, and forms a compound of indefinite composition which crystallizes with a large water content and in turn pushes apart the cement particles and ultimately destroys the structure. While experimentally it has been shown that lime can be replaced with strontium or barium, and the alumina, in part, by iron or chromium oxide and hydraulic material of considerable value obtained, none of these ingredients have been suggested as being of commercial value except the iron oxide. This material of late years has been attracting considerable attention as an ingredient for cement. Its entire substitution, however, or the alumina has proven unsuccessful in the manufacture of Portland cement. Attempts have been made, but in every case it has been found that it is impossible to make a cement entirely lacking in alumina. The iron ore cements must have alumina present or they are of no value, and in the finished cement the iron oxide is of no more value than any other material which might be present and would reduce the alumina content. Of course, this statement does not deny the value of the iron oxide as

TABLE No. 1—TENSILE STRENGTH IN POUNDS PER SQUARE INCH OF NEAT AND 1:3 SAND BRIQUETES OF VARIOUS CEMENTS WHEN IMMERSED IN FRESH AND SEA WATER.

	Slag Cement (E).		Natural Cement (I).			
	Neat Briquettes		Neat Briquettes		Sand Briquettes	
	Fresh Water	Sea Water	Fresh Water	Sea Water	Fresh Water	Sea Water
4 weeks	549	686	282	302	116	111
13 "	558	730	368	368	196	165
26 "	534	652	378	236	182	99
52 "	422	432	366	283	260	208

	Mixture, Natural and Portland cements (J).				Portland Cement (K).	
	Neat Briquettes		Sand Briquettes		Neat Briquette	
	Fresh Water	Sea Water	Fresh Water	Sea Water	Fresh Water	Sea Water
4 weeks	221	258	247	190	865	1100
13 "	216	311	201	256	910	927
26 "	204	286	257	318	830	900
52 "	250	244	218	276	463	923

	Portland Cement (L).		Portland Cement (M).	
	Neat Briquettes		Neat Briquettes	
	Fresh Water	Sea Water	Fresh Water	Sea Water
4 weeks	595	623	748	837
13 "	557	507	630	799
26 "	550	673	610	570
52 "	407	233	507	277

	Slag Cement (F).			
	Neat Briquettes		Sand Briquettes	
	Fresh Water	Sea Water	Fresh Water	Sea Water
4 weeks	416	468	210	180
13 "	511	512	306	241
26 "	590	348	246	258
52 "	536	210	336	280

	German Iron Ore Cement (A.)				Special Low Alumina Portland Cement (B).			
	Neat Briquette		Sand Briquettes		Neat Briquettes		Sand Briquettes	
	Fresh Water	Sea Water	Fresh Water	Sea Water	Fresh Water	Sea Water	Fresh Water	Sea Water
4 weeks	535	702	120	134	764	714	242	252
13 "	714	746	221	166	803	554	311	355
26 "	726	802	234	236	800	622	418	320
52 "	764	656	256	204	768	748	370	310

	Portland (C).				Typical Portland No. 47 (G).			
	Neat Briquettes		Sand Briquettes		Neat Briquettes		Sand Briquettes	
	Fresh Water	Sea Water	Fresh Water	Sea Water	Fresh Water	Sea Water	Water	Sea Water
4 weeks	672	748			604	821	268	206
13 "	744	808			636	136	300	238
26 "	708	768			658	**	304	258
52 "	636	764			674	**	350	205

	Typical Portland Cement No. 47 (G).			
	Specimens stored in damp closet for 24 hours; then for 2 days in fresh water.		Specimens stored in damp closet for 24 hours; then for 6 days in fresh water.	
	Neat Briquettes		Neat Briquettes	
	Fresh Water	Sea Water	Fresh Water	Sea Water
4 weeks	672	959	700	926
13 "	765	904	723	840
26 "	713	852	734	940
52 "	622	738	660	598

	White Portland (H).				French Portland Cement (D).	
	Neat Briquettes*		Sand Briquettes		Neat Briquettes	
	Fresh Water	Sea Water	Fresh Water	Sea Water	Fresh Water	Sea Water
4 weeks	658	996	212	164	539	511
13 "	808	970	290	200		
26 "	742	788	366	162	702	656
52 "	630	502	292	204	776	706

*A second lot of briquettes gave substantially the same results.
** Broke in handling before placed in testing machine.

a flux in the manufacture.

Mr. Bates, after substantially setting forth the above facts, refers to the slight growth in the manufacture of iron ore cements in Germany where it originated in patents taken out by the Krupps in 1901 after experiments and arguments of Dr. Michaelis on this subject. Experiments made with these cements do not, according to Mr. Bates, show results better than the ordinary Portland cements in either sea water or fresh water, and Candlot's experiments in France with various high iron oxide cements made by the latter are also cited, showing results at 7 and 28 days and 5-year periods as corroborative of these facts. High silica cements experimentally made by Mr. Candlot, containing as high as 26 and 27 per cent silica, with an alumina content of 2.5 per cent are also referred to, as is also the fact of Candlot's use of a flux, generally iron oxide, in the preparation. These latter experiments of Mr. Candlot's gave results considerably above normal Portland cements when immersed in sea water and Mr. Bates suggests that these high siliceous cements should receive more attention by the investigator, the manufacturer and the consumer.

Experiments made at the University of Illinois mentioned in the thesis of A. A. Williams, 1910, are referred to as giving contradictory results, and the paper concludes with an extensive series of tests made at the Atlantic City Laboratory of the Technologic Branch of the U. S. Geological Survey, now part of the Bureau of Standards. These tests, which are published for the first time, are given herewith:

Referring to Table No. 1 Mr. Bates states:

"An examination of Table No. 1 shows that the neat briquettes made of Portland cement of normal composition retrogrades considerably in strength after the 13 weeks period. In this class have not been placed the cements K and C, since both of them show rather high iron oxide content, although they could hardly be called iron oxide cements. Cements L and M were simply chosen at random from standard Portland cements, while the typical Portland is a mixture of equal parts of a number of standard Portland cements. The effect of aging, even for a short period in fresh water before subjecting the cement to the action of sea water, is very closely shown, and suggests a practice which should be observed, when at all possible, in all cement used in sea water. The rather remarkable behavior of the white Portland, in view of the theory under which high iron oxide cements are used, is striking and unexplainable. The data on E has been given largely because this cement, if we are rightly informed, belongs to that class of cements called by the Germans "Eisenportland" cements, which are mixtures of slag with Portland cement, though contrary to the German practice more slag has been used in its manufacture than Portland cement. This cement, while it shows retrogression, does not show the decrease in strength which the true slag cement does.

"The sand briquettes of all the classes compare rather favorably, and it would be difficult to form an opinion of the relative value of any class from the behavior of the mortars alone. With the exception of the cement J, all the sand briquettes show less strength in sea water than in fresh water at the end of a year; those of cements I, F and white at one year do not show a retrogression since the previous period of testing."

Compression tests do not show any superiority of the iron ore cements over the Portlands, and taking the results as a whole it cannot be positively stated, says the writer, that the iron ore cements show superiority over the Portland cements.

Mr. Brown's contribution to the discussion covers very fully the history of marine, or iron ore cements. and gives a series of experiments made in the producing of cements of this character from the ferruginous miocene shell marls of the Norfolk and Yorktown districts in Virginia which furnish excellent raw material for the manufacture of cement of this character. These shell marls have been used for the past year in the manufacture of Portland

cement at Norfolk, Virginia, which cement has given excellent results in fresh and salt water. The experimental cements made by Mr. Brown at Yorktown, show varying percentages of ferric oxide, alumina, magnesia and sulphur tri-oxide the ferric oxide content running as low as 2.64 and as high as 8.71, and the alumina running as low as 1.43 and as high as 7.8 per cent.

Tables are given showing the analyses of the various cements made out of the Virginia marls as compared with the German iron ore cements and the ordinary Portland cements. The paper is replete with most interesting figures of tests and short and long time periods and in fresh and salt water, and with the effect of the excess of iron as a flux in manufacturing the cement. In this latter detail the writer contradicts the well-known theory that oxides of iron is a better fluxing material for Portland cement than alumina.

Summing up the causes of the failure of cement structures exposed to the action of sea water, Mr. Brown states as follows:

"The problem of the underlying causes for the faliure of cement structures exposed to the action of sea water is so complex that it is not surprising that there are many and opposing views held by able investigators, who have spent much time and earnest effort in the attempt to solve the question.

"The chemical and physical action which stands out clearly in this work, extending over a period of nearly two years, can be summed up as follows: When disintegrating effects occur in concrete exposed to the action of sea water, and where there are variations in level of the water, due to wind, wave and tide, these disintegrating effects may be rightly divided into two main causes—mechanical and chemical. Mechanical action is influenced (first) by alternate drying and wetting of the surfaces, due to wind, wave and tidal action; (second) abrasions from ice or floating objects; (third) formation of expansive crystals where freezing occurs, or where double salts may be formed within the concrete body.

"This brings us to the second main cause of disintegration, namely, chemical action, since the formation of the double salts is first brought about by substitutive chemical reactions. Such double salts as calcium aluminum sulphate occupy more space than the original compounds. The dissolving, replacing and formation of these new crystalline substances act in the same manner as ice crystals within the rocks. Such ice crystals have been very effective in producing disintegration of the archaian rocks covering the earth's surface.

The hydraulic cements which are best fitted to withstand satisfactorily all disintegrating effects of sea water (excepting those which are purely mechanical) are those which give the greatest density of concrete structure; and which are relatively high in silica, low in magnesia and sulphur trioxide, and in which the content of alumina does not exceed that of the ferric oxide."

The subject, however, would not be complete if allusion were not made to the recent experiments conducted with miocene shell marls at the works of the Virginia Portland Cement Works, by Edwin C. Eckel who used glaconite (greensand) in connection therewith and produced excellent marine cement.

	Brand.												
	A	B	C	D	E	F	G	H	I	J	K	L	M
SiO_2	23.44	20 37	22 51	23.04	27.77	30.19	21.50	22.66	22.51	20.90	21.36	19.82	22 07
Fe_2O_3	7.48	8 97	4.86	2 51	.60	1.64	2.28	.55	4.86	2.44	3.73	2.10	2 31
Al_2O_3	2 98	3 64	5.42	7 18	13.87	11 08	8.12	8.61	5.42	6.02	6.77	7.62	6 95
CaO	61.86	61.42	61.87	63 60	44.07	46.16	62.23	62.46	61.87	32.96	63 43	62.04	62.33
MgO	.50	.82	.93	1.04	4.49	2.17	3.24	1.10	.93	21.21	1.59	3.90	2 28
SO_3	1.72	1.19	1.47	.43	1.22	1.10	1.45	1.64	1.46	2.15	1.41	1.43	1.54
Na_2O	.20	1.54	.17	.23	.42	.29	.18	.40	.17	.51	.09	.24	.31
K_2O	.28	.24	.48	.63	.11	.64	.38	.53	.46	2.53	.31	.26	.57
H_2O (-105°)	.42	.....	.....	.....	.....	.....	.38	.36	.....	.27	.43	.90	.45
CO_2	.69	1.01	.89	.27	2.10	.72	.12	.63	.89	10.17	.78	.92	.45
Ig. loss	.09	1.06	1.82	1.17	2.68	3.28	.39	1.07	1.82	.95	.36	.90	.92
CuO	.51	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
CaS	.....	.....	.....	.....	2.84	2.74	.....	.....	.....	.....	.....	.....	.....
	100.17	100.26	100.41	100.10	100.19	100.16	100.27	100.01	100.41	100.11	100.26	100.13	100.18

TABLE II—CHEMICAL ANALYSIS OF CEMENTS, THE TENSILE STRENGTH OF WHICH ARE SHOWN IN TABLE I.

THE FRENCH CEMENT INDUSTRY IN 1911

M. CANDLOT, the distinguished French engineer, chemist and manufacturer, sends us the following brief but interesting summary of the industry in France during the year 1911:

During the year 1911, the cement industry in France was very active, principally due to the development of reinforced concrete construction. The demand for cement has been very large and it was with difficulty that the cement mills were enabled to take care of their orders. This increase in the consumption of cement could only be filled by an increase in production. A cement mill in fact cannot increase its production in a short time except within restricted limits, for the reason that a very high motive power is necessary, principally due to the use of rotary kilns. It usually takes some time before new machinery can be installed. The foregoing will explain the difficulties encountered this year. They are, however, temporary, for it will not be long before the production of cement will be found to equal the requirements of the consumers, as there are many plants in course of construction and mills are being enlarged in many sections.

There has been no new mill put in operation during this year. A very important plant is under construction at Couvrot, near Vitry-le-François. It is expected that it will be producing during the early part of the year. Other mills have been projected but it is not yet known when they will be constructed. The demand for a good quality of cement is becoming more frequent every day, and it will not be very long before a Portland cement of a still higher quality will be called for. This is the outcome of reinforced concrete construction in which the quality of cement plays such an important part. The consumers will realize more and more the possibility of important economies in their work as well as increasing the security of the construction by using cement of a high standard. There has been great progress made in this direction in developing the fineness of the cement through grinding.

While heretofore a cement showing 20% to 25% residue on a sieve of 4,900 meshes per sq. cm. (178 meshes per lin. in.) was considered very fine ground, it is now customary to find mills delivering cement showing a residue of only 5% to 10%. Fineness, however, is not alone the element which promises to increase the value of the cement. The chemical composition always plays an important part, and it is in this direction the new researches should be directed. It would be very interesting to be able to supply the consumers with cement testing in tensile strength 50 to 60 kgs. per sq. cm. (711 to 853 lbs. per sq. in.) when mixed neat, and 30 to 40 kgs. (426 to 568 lbs. per sq. in.) in sand mortar. This cement, when used in conrete, would in practice give, after 10 to 15 days, strengths of 250 to 300 kgs. in compression (355 to 426 lbs. per sq. in.)

No important progress can be noted in the line of manufacturing. The rotary kiln is coming more and more in use, but kilns of very large dimensions are not always installed. Those measuring 60 m. (196 ft.) in length and 2.50 to 3 m. (8 to 10 ft.) in diameter are about the average one finds in kiln dimensions.

Manufacture by means of so-called thick slurry continues to gain ground, but apparently, without any good reason. When the raw materials are soft the wet process is, of course, adopted, but when the raw materials are very hard it is not apparent that any advantage is gained by adding 35% of water, which must eventually be thrown off by evaporation.

Dr. Brunn has thoroughly demonstrated that the dry process in the case of hard raw materials, which can readily be dried, is more economical than the semi-wet process. He has also shown that the kilns operated by using the dry process should be longer than those where the wet process is used, this notwithstanding the fact that such a conclusion seems in the face of it to be paradoxical.

In grinding, the compound crushers are mostly in demand, and it seems that this is in the right direction, for this kind of mill is less cumbersome and insures a very large output.

High speed mills are, practically, not in use in France. Tube and ball mills are found in almost every plant.

A German technical paper devoted to the installation of steam boilers and engines has recently published an article dealing with the increasing use of reinforced concrete as a substitute for brick in the construction of boiler foundations, flues, and setting generally. For tubular boilers a 15-in. double wall is recommended, the inner 5 in. thick, and the outer 6 in. thick, with an intervening space of 4 in., the wall reinforced vertically and horizontally by a network of round bars, and the two elements of the wall kept in their correct relative positions by distance pieces. Any walls in direct contact with flame should be not less than 12½ in. thick, and constructed independently to the outer walls so that they can be renewed or repaired as occasion demands. The recognized advantages of reinforced concrete for the purpose are stated to be excellent insulation and economy in both first cost and maintenance.—*Ferro-Concrete.*

The first reinforced concrete motorboat, recently built in Germany has an overall length of 24 ft., a width of 6 ft. and is equipped with a 5 H. P. engine. The outside surface of the boat is coated with a magnesium sulphate coating which is rubbed smooth with pumice, oil and sawdust, giving a very high polish.

DISCRIMINATION IN CEMENT RATES

The Interstate Commerce Commission recently handed down a ruling on cement freight rates in deciding the case of the Elk Cement & Lime Co., and others, against the Baltimore and Ohio and other railroads. The complaint was that:

Rates on cement in carloads when shipped from the Lehigh Valley district in eastern Pennsylvania and western New Jersey to Detroit, Mich., and other central freight association points, found to be unduly discriminatory against shippers from the Michigan district, and defendants are required to remove such discrimination.

The report of the commission states that it is alleged in the complaint, that freight rates on carload shipments of cement from manufacturing plants located in eastern Pennsylvania and western New Jersey, known as the Lehigh Valley district, are so low when compared with rates from the plants of complainants to consuming points in central freight association territory, that they constitute undue and unreasonable preference and advantage to shippers from the Lehigh Valley district. The Commission is requested to require the carriers making and participating in the rates to cease such discrimination. The Commission is also asked to establish commodity rates from the plants of complainants to all points in Central Freight Association territory which shall bear a proper and just relation to commodity rates now in effect to the same points from the mills located in the Lehigh Valley district.

The first cement mills of any importance in this country, the Report recites, were erected in the Lehigh Valley district. Prior to the time cement was produced in large quantities in this region practically all of this commodity was imported from Europe. It is asserted by complainants, and not disputed, that very low rates of freight were made from seaboard points to induce the movement of the imported product to the consuming markets throughout the country, particularly to points in Central Freight Association territory. After cement production was well established in the Lehigh Valley district, the low rates were continued and have been maintained with some variation, but on substantially the same basis, to the present time. About the year 1897 cement began to be manufactured in large quantities from rock deposits around Detroit as well as from deposits of marl found near the shores of Lake Superior.

In developing their field complainants assert that they have operated under a freight-rate handicap ever since they began the manufacture of cement. This was not felt to any disastrous extent so long as cement at the mills sold for $1.25 per barrel or more, and prior to a general advance in freight rates from and to points in Central Freight Association territory, which took place in the year 1907. The comparatively low freight rates accorded the Lehigh Valley district producers enable them to invade the Detroit and other Central Freight Association consuming markets and sell cement therein at prices which are below a reasonable profit to Michigan producers, and that the Lehigh Valley district mills have entered into an agreement whereby cement is sold throughout Trunk Line territory at prices sufficiently high to enable them to sell in Central Freight Association territory at an actual loss, thus making prices in the latter territory which are ruinous.

Rates from the Lehigh Valley district mills to Detroit are 11.25 cents per 100 lbs.; from Detroit to the Lehigh Valley mills the rates to some of the Lehigh Valley district points are 13½ and to others 15½ cents. The rate from the Lehigh Valley district mills to Chicago is 15 cents, and from Chicago to New York 20 cents. The following table gives sample rates from one of the Michigan mills to points in Central Freight Association territory, which may be compared with rates from Coplay, Pa., to the same point in another table set out below:

Rates from Newaygo, Mich., 188 Miles from Detroit.

To—	Rate per 100 Pounds. Cents.	Distance. Miles.	Rate per Ton per Mile Mills.
Toledo, Ohio	6½	216	6.5
Findlay, Ohio	8½	260	6.5
Springfield, Ohio	9½	347	5.4
Van Wert, Ohio	8	211	7.5
Dayton, Ohio	9½	325	5.8
South Bend, Ind.	6	165	7.2
Elkhart, Ind	6	166	7.2
Fort Wayne, Ind.	7	178	7.8
Logansport, Ind.	8	236	6.7
Indianapolis, Ind.	9	309	5.8
Chicago, Ill.	6	213	5.6
Kankakee, Ill.	6	263	4.5
Danville, Ill.	9½	319	5.9
Decatur, Ill.	10	396	5.0
Springfield, Ill.	11½	434	5.3

Rates from Coplay, Pa.

To—	Rate per 100 Pounds. Cents.	Distance. Miles.	Rate per Ton per Mile. Mills.
Toledo, Ohio	11.25	650	3.4
Findlay, Ohio	11.60	694	3.3
Springfield, Ohio	12.10	720	3.3
Van Wert, Ohio	12.45	710	3.4
Dayton, Ohio	12.30	744	3.3
South Bend, Ind.	14.30	791	3.5
Elkhart, Ind.	14.30	793	3.5
Fort Wayne, Ind.	13.30	725	3.6
Logansport, Ind.	14.50	825	3.5
Indianapolis, Ind.	13.80	821	3.3
Chicago, Ill.	15.00	881	3.4
Kankakee, Ill.	15.00	891	3.3
Danville, Ill.	15.00	891	3.3
Decatur, Ill.	16.7	975	3.4
Springfield, Ill.	17.9	1,013	3.5

It is a rule too well settled to need discussion that as distance increases the rate per ton per mile decreases, and merely because a greater distance point has a lower rate per ton per mile than a shorter distance point, discrimination does not necessarily result.

It is charged by the complainants that when Lehigh Valley district shippers have supplied the eastern markets, they "dump" their surplus in Detroit and other Central Freight Association points at less than cost of manufacture and make prices so low that the business is no longer profitable. It appears to be the practice of all cement producers to "dump" their surplus product in certain large competitive consuming markets, but the complainants assert that when they undertake to rid themselves of their surplus they are confined in their markets and are compelled to ship under rates of freight which are much higher than those enjoyed by their competitors. From the figures given herein it is clearly apparent that the Michigan cement manufacturer cannot ship to the East for any great distance, nor can he do so to most points in Central Freight Association territory except he meets the competition from the Lehigh Valley district shippers.

Considering all the facts and circumstances, the commission is of opinion that there is discrimination against the mills of the complainants for which the defendants in this case are responsible and which they may be properly required to remedy. The discrimination against complainants is represented by the difference between the rates charged them and the Lehigh Valley district shippers for relative distances, but from this record it is impossible to determine whether that discrimination extends to all competitive points in Central Freight Association territory or whether there ought to be a change of rates to the same extent to all such points. Under these circumstances the commission will not make an order at this time, but will expect defendants to check in rates to and from points in Central Freight Association territory which shall not discriminate against any mills.

In this connection the *Wall Street Journal*, for February 27, states that a recent decision of the Interstate Commerce Commission holds that the Universal Portland Cement Co., which is owned by the United States Steel Corporation, and which is located within the switching limits of Pittsburgh, is unduly favored by railroads in matter of freight rates to consuming territory east and west. Decision was rendered on complaint of Alpha Portland Cement Co., of Manheim, W. Va., 130 miles east of the Buffalo-Pittsburgh line, which divides Trunk Line and Central Freight Associatoin territories.

Universal is considered as being in Trunk Line territory, where Manheim is located, as to shipments east, and in Central Freight Association territory on Central Freight Association shipments. Universal, therefore, on shipments to Central Freight Association territory derives the benefit of the Central Freight Association carriers, which is 73 1/3 per cent of the sixth class mileage scale for similar distances.

Manheim rates to Central Freight Association territory, however, are made upon the old-established basis long in effect between Trunk Line and Central Freight Association territories, of a certain percentage of the New York-Chicago rate, dependent upon the Central Freight Association percentage group, in which point of origin or destination is situated. The present comparative basis from Manheim is the result alone of a strict observance of the Buffalo-Pittsburgh line in rate construction.

It is held, considering the complaint upon its substantial merits from a transportation standpoint, without regard to any arbitrary geographical line of demarcation between different methods of tariff construction, that the relative adjustment between the two mills is unduly preferential to Universal.

As a general proposition, commission says that when general rate adjustments in and between large territories, which contemplate substantial justice between all shippers generally, result in individual instances of disproportionate inequality, they fail in their purpose to that extent and their strict observance in such cases upon no other ground that the arbitrary theory of their existence should yield to the extent necessary to prevent gross injustice. Just as many other general rules are necesasrily subject to exceptions. Reparation to be awarded upon satisfactory proof of the amount due under these findings on complainant's shipments within statutory period.

CONCRETE BLOCKS IN NEW YORK

THE following specifications were recently adopted for concrete block in Greater New York:

Hollow concrete building blocks may be used for buildings not more than three stories nor more than 36 ft. in height, under the following conditions:

No hollow concrete blocks shall be used unless made of the following composition: One part Portland cement, and not more than five parts of clean, coarse, sharp sand and gravel, or a mixture of at least one part of Portland cement and not more than five parts of crushed trap rock or other suitable aggregate approved by the superintendent of buildings. The aggregate shall be of such fineness as to pass through a one-half inch ring and be free from dirt or other injurious matter, and Portland cement shall be a true Portland and be up to the standard requirements set by this bureau.

All concrete blocks shall be cast true and square, and be of uniform shape and thickness when laid in courses. No such blocks shall be used until complete and satisfactory tests have been made by the manufacturer under the direction of the superintendent of buildings, and until an approval for the use of such blocks has been obtained.

No blocks shall be approved that do not at the age of 28 days develop a compressive strength of at least 1,500 lbs. per sq. in. of net section.

In no cases shall the hollow spaces of the concrete block exceed 33 1/3 per cent. of the cross-section of the block. The thickness of walls or webs of such blocks shall not be less than one-fourth of the height of the blocks, but in no cases less than 1½ inches.

The thickness of walls for any buildings where hollow concrete blocks are used shall not be less than is required by the building code for brick walls. All such walls shall be laid in Portland cement mortar. All outside walls below grade must be filled in solid. No walls composed of hollow concrete blocks shall be loaded in excess of 100 lbs. per sq. in. of the gross section of the wall—that is, no deduction being made for hollow spaces in figuring the area.

Where beams or girders rest on such walls, suitable templates of iron, steel, or stone shall be provided under their ends, or the blocks under them shall be solid. Concrete lintels spanning an opening over 3 ft. 6 in. wide shall be reinforced by steel bars.

Every block must have stamped thereon the name of the manufacturer or the manufacturer's mark.

All walls of hollow concrete blocks, and beams used in same, must be anchored in accordance with Sections 41 and 60 of the building code.

The cement shows are—next perhaps to the trade and engineering papers—the greatest educational medium of the industrial world. It is only by taking advantage of every opportunity offered that modern business conditions are successfully met, and the engineering and contracting profession are fortunate in having prepared for their inspection and study the hundreds of exhibits that will make up the cement shows.

CONSULTATION

216. To Determine Comparative Value of Different Sands

"With 3 or 4 sands in close proximity to a building site how would you go about the work of determining the best sand by mechanical analysis? The sand is to be used in the construction of a reinforced concrete building."

216. DISCUSSION BY JAMES L. DAVIS*

The following mechanical analysis test for sand was devised several years ago while the writer was in charge of the laboratory of the Board of Water Supply of the City of New York:

Samples of the material proposed for use in mortar or concrete shall be prepared for testing by passing them through a No. 4 sieve. Of the material passing this sieve not more than 95 per cent. shall pass a No. 8 sieve, not more than 40 per cent. a No. 50 sieve and not more than 15 per cent. a No. 100 sieve.

(a) Material in which the percentage passing any one sieve or two sieves exceeds the specified percentage may be used, provided there is a deficient percentage passing the other sieves or sieve under the limiting percentage equal to at least twice the excess.

The sieves for testing shall be defined as follows:
No. 8 mesh holes 0.0955 ins. wide, No. 23 wire
No. 50 mesh holes 0.0110 ins. wide, No. 35 wire
No. 100 mesh holes 0.0055 ins. wide, No. 40 wire

In deriving this test strength and mechanical analysis tests on 120 natural and 20 artificial sands (crushed rock or screenings) were used. The natural sands were representative of the deposits found along the ninety mile route of the Catskill Aqueduct and were not selected as especially high grade materials. Tensile tests on ordinary briquettes and compressive tests on two inch cubes were made.

In order to avoid a too lengthy discussion only the tensile results will be considered here.

The average tensile strength of the 120 natural sands was 348 lbs. per square inch at three months' age. The average of the 20 artificial sands was 599 lbs. The tests were made at various times, and several brands of Portland cement were used, all passing the specifications of the American Society for Testing Materials. There were in general six briquettes in a test. 300 lbs. per sq. in. at three months' age in 1:3 mortar was taken as the minimum acceptable strength in the derivation of the test.

Modification (a) was introduced for two reasons: (1) Artificial sands often contain a large percentage of very fine materials, though they give high strength tests, while natural sands containing as much fine material fail to develop the required strength. Artificial sands usually contain a larger percentage of particles too coarse to pass the No. 8 sieve than do natural sands. These coarse particles compensate the excess of fine ones. This class of sands would be rejected if the test were unmodified.

(2) Provision must be made for accepting finely graded natural sands in localities where no others are to be found. Of 120 natural sands tested, 24 were in this modified class. Their average strength was 326 lbs. per sq. in., though 9 of the number failed by small amounts to develop 300 lbs. Thirty-five of the 120 sands failed to pass by the modified test. Their average strength was 268 lbs. per sq. in. Micaceous or other strongly laminated sands give relatively higher strength in tension than in compression.

The writer prefers to test sands by the strength of the mortars they produce in direct comparison with Ottawa sand, as recommended by the American Society of Civil Engineers. The above test has proved useful in numerous cases where time was not available for strength tests to mature, the analysis test being later verified by strength tests.

For high class work the writer would not use a sand which did not pass the analysis test well within the limits set, unless proved acceptable by a strength test. It should be remembered that the question of the rejection of sands because of fineness is usually an economic one. The loss of strength due to fineness can be compensated by the use of an additional amount of cement. A more perfect analysis test based on the uniformity co-efficient as in tests of filter sands probably could be devised, but a larger number of sieves would be required. In making the above test the sands should be thoroughly dried. A one hundred gram sample should be used. Scales weighing to grams are required. The purpose of the test was not to set a standard difficult to reach, but to secure materials safe for use under ordinary conditions. The following test of a natural sand illustrates the application:

	Per cent. passing
Sieve No. 4	100
" " 8	100
" " 50	37
" " 100	5

*Mt. Vernon, N. Y.

The percentage passing the No. 8 sieve exceeds the specified percentage by 5%, but there is a deficient percentage passing the No. 50 sieve of 3%, and the No. 100 sieve of 10%, the combined deficiency being 13%. This is greater than twice the excess passing the No. 8 sieve, 10%, and the sand therefore passes the modified test. This sand developed 340 lbs. strength.

234. Cost of Concrete Cornice

"I have been looking for some data on the cost of concrete cornices on large buildings. Any information on this will be appreciated."

234. Discussion by Chester S. Allen*

We have recently designed and supervised the construction of a twelve-story reinforced concrete cotton storehouse for the Massachusetts Cotton Mills in Lowell, Mass., in which we had a rather elaborate cornice, as will be seen from the accompanying photograph of the building, and cross-section of the cornice.

We kept very complete cost data of this building and are giving below the unit costs of this cornice.

Concrete ....$6.52 per cu. yd.
Forms ....31.76c. per sq. ft.
Steel reinforcement...$58.95 per ton.

In this last item cost of bending and placing of steel is $20.29 per ton.

234. Additional Discussion (Editorial).

The cornice on the work referred to above was described in Cement Age for April, 1911, and the following notes which cover in detail the construction and will be of interest here, are taken from that issue:

The walls of the cotton storehouse at Lowell, Mass., are at the roof line, 18 in. thick, the roof slab being cast integral with the walls. The wall above the top tier of windows is in effect a continuous re-

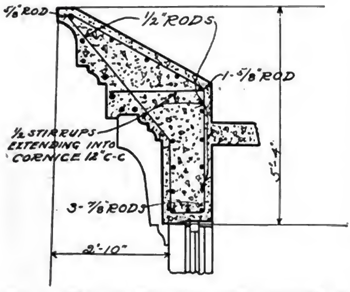


FIG. 1—SECTION SHOWING CONSTRUCTION OF CORNICE.

*Lockwood, Greene & Co., Boston, Mass.

FIG. 2—A PORTION OF THE FINISHED CORNICE.

inforced concrete girder resting on the pilasters between the windows. At each bay there is a concrete bracket projecting out about 15 in. from the wall face and being about 3 ft. in height, starting at a point some 6 in. below the top of the upper row of windows. These brackets give the appearance of supporting the heavy continuous cornice above them, but in fact the cornice is self sustaining and is firmly anchored into the wall and roof slab.

The cornice itself is about 3 ft. 6 in. deep and overhangs from the face of the wall some 3 ft. The accompanying photograph shows quite clearly the reinforcing rods in place and the forms erected ready for concreting. The Aberthaw Construction Co., of Boston, the contractors, designed the forms, which are 2 in. lumber surfaced on the concrete side and supported on a staging resting on scaffolding which projects out cantilever fashion from the top story of the building. It will be noted that there are reinforcing rods firmly embedded in the wall about every 18 in. and these are then bent out at an angle of about 45 degrees to a point nearly at the top outer edge of the cornice, then back and down to a continuous rod near the inner surface of the exterior wall, this rod being securely wired to other rods which extend down into the wall and are bent over to a horizontal position and extend out into the cornice. The inner ends of the diagonal cornice rods are hooked around this continuous longitudinal rod as shown in the illustration. The diagonal rods are held in position by six longitudinal reinforcing rods to which they are firmly wired.

It is evident that the arrangement of the reinforcing of this cornice is such as to render it absolutely self-sustaining and that there will be practically no danger at any time of any part of it working loose and dropping. The fact that it is cast practically as a monolith gives added assurance of its stability.

239. The Storage of Explosives

"What is the comparative value of concrete and other masonry structures for use in construction where explosives are handled and stored?"

239. Discussion by W. S. Ferguson*

In reference to a discussion on buildings where explosives are stored and in regard to the buildings we built† at Glenwillow, Ohio, for the Austin Powder Co., there is very little to say except that they were built with walls 5 ft. thick, and a light wood roof, over-lapping the walls, but not securely anchored into them.

The editorial discussions in March says that the idea of constructing the buildings in this manner was in case an accidental explosion should occur, it would spend its force upward. I might add that this is exactly what has taken place in two or three instances at these buildings and in every instance no damage whatever was done, except to blow the roof a 100 ft. or so away from the buildings, and in one case the roof landed intact, and it was only necessary for a few men to pick up the roof and replace it on the building. Not the slightest sign of any disintegration or cracks of any kind have appeared since the erection of these buildings and in my own opinion I believe the walls could be constructed not over 18 in. thick and the same result be acomplished.

Very little reinforcing was used in any of this work, except the engine house, which is within four feet of one of the powder magazines and at the time of the explosion of this one magazine, there were men working in the engine room, and did not feel any shock to speak of.

Forms Required

Sometimes basements are lower in height and the first floor has especially heavy beams and requires large supporting columns, so that forms cannot be remade quickly enough for the floor above; in other buildings, construction loads on the first floor may require the basement forms to remain. In such cases the basement forms must be figured as an extra set.

Vertical members, such as walls thicker than 4 in. or columns, will bear their own weight when quite green, while horizontal members, such as floors, must harden until the concrete can sustain the dead weight and the load during construction.

The weather has a decided effect upon the time of form removal. In the cool weather of the spring and fall, even if there is no frost, concrete hardens slowly. Concrete should never be allowed to freeze, and therefore the forms may have to remain for several weeks or even until the building is completed and then taken down very carefully.

*Consulting Engineer, Cleveland, O.

†These buildings, which are also referred to in the March Editorial Discussion of this question, were built in 1905 by the Carey Construction Co., of Cleveland, O.

CONCRETE RESIDENCE CONSTRUCTION AND THE ANNUAL HOUSEBUILDING NUMBER

Cement Age for May will be the seventh annual House Building Number, and the *Consultation Department* should present questions and discussions along many of the intereting phases of the work.

Questions and Discussions are invited especially along the line of practical problems in house construction.

Following are some of the questions which have come up during the past year which will involve house-building problems. Further discussion would be of interest here.

159. Voids by Water Displacement

"It has always seemed to me that the easiest way, and, moreover, the most accurate, to determine the voids in material for concrete, is by 'water displacement.'

"This is to ask you if there is any company manufacturing a simple effective apparatus which would do the work required in the field for determining the necessary data."

204. Sound Transmission and Reverberation in Concrete Buildings

"Several prospective clients of mine have questioned the use of reinforced concrete for their new buildings owing to the possibility of sound transmission. What advise can you give me on this?"

224. Cost of Concrete Walls

"I quote from page 204 of your November issue: 'Rough hollow blocks may be had of almost any particular shape from machines in use in almost any cement block factory, and are the cheapest form in which concrete can be built into walls of any height'.

"Blocks are one kind of unit wall construction. Are they the cheapest?"

230. Making Expansion Joints Watertight

"Have had some trouble with cracks in a porch floor, and the use of bitumen filled expansion joints has been suggested. Can you explain to me a little more fully how a bitumen filler is used in expansion joints, for with any filler in a joint of this sort, I should think it would be squeezed out when the concrete expands and then leave a crack when the concrete contracts again."

231. Waterproofing a Porch Floor

"I have been told that the only way to make a large concrete floor watertight, is to put in the bottom reinforced slab with expansion joints; cover this with regular waterproofing of tar felt and coal tar pitch, then put on two or three inches of cinders as a bed and cover this with Portland cement finish, preferably with metal lath in it and with expansion joints in the top finish. This sounds satisfactory. Do you know any objection to it? Would not considerable water accumulate on top of the waterproofing which should be drained off?"

THE CONSTITUTION OF PORTLAND CEMENT

CRITICISM having been made by Dr. Clifford Richardson upon an article appearing in CEMENT AGE for December, written by Dr. Otto Schott and entitled "Production and Testing of Portland Cement," Dr. Schott has sent us a communication replying thereto. He states that Dr. Richardson is in error if he believes that he (Dr. Schott) is ignorant of the recent work of the Geolophysical Laboratory. Dr. Schott goes on to explain his position as follows:

The article "Production and Testing of Portland Cement," published in the December number of CEMENT AGE, however represents simply an extract of a referendum by which I illustrated in February, 1911, before the Convention of the German Cement Manufacturers, the stand of the American cement researches at that time. I could of course then not yet state that later Shephard changed his opinion, admitting still a tricalcium-silicate in cement clinker, because this was made known only in April, 1911, through the publication in the *Journal of Industrial and Engineering Chemistry.*

On the other hand, Shephard had already in 1910 admitted the existence of a tricalcium aluminate and I could therefore make this the object of criticism in my referendum in February, 1911. As at the same time Keisermann in his work on cement was inclined to admit the tricalcium-aluminate, I wanted to show my opposite standpoint and to prove that acording to my work and experiments it is impossible that tricalcium-aluminate exists as such in cement clinker.

That with this opinion I am not the only one, has been proved by the statements of the late Prof. Michaelis, who in the discussion following my report to the convention, said :

I only wish to express my great satisfaction with the lecture of Dr. Schott and to state that I agree entirely with his standpoint, which deviates from the latest American researches. I also do not admit a tricalcium-aluminate. I, however, do not presume now that Orthosilicate has lime in solution. This does not seem to be the case. Then naturally, the existence of the free lime in the cement clinker is possible. However, I still do not admit that there is tricalcium-silicate and tricalcium-aluminate in the cement clinker.

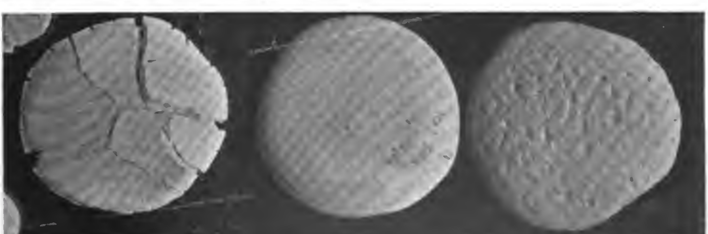
In April, 1911, there appeared the publication of new works of Shephard according to which he had in the three component system found a tricalcium-silicate and made the assertion that this is contained in cement.

The fact is perfectly known to me, but because CEMENT AGE had solely given a translation of a referendum of February, 1911, it is natural that nothing was therein contained of the works published after that date by Shephard. Probably at the present time this latest work of Shephard is being discussed at the yearly convention of the German Cement Manufacturers.

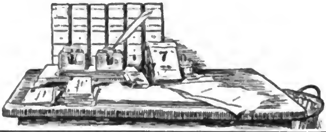
Dr. Schott also quotes from a paper of the late Dr. Michaelis published in *Tonindustrie-Zeitung* in which Dr. Michaelis, after referring to the work of Messrs. Shephard, Rankin and Wright of the Carnegie Institute at Washington, states that the researches of Dr. Schott by which he had shown that "pure (melted only from silicate acid and lime) tricalcium-silicate is no chemical combination, but a mix of Dicalcium-silicate with free lime and that 4 per cent alumina are sufficient to produce a tricalcium-silicate, hydraulic and constant in volume, agreed very well with the researches made by Shephard."

Dr. Schott concludes his communication by stating:

"I personally stand therefore before as after by the standpoint that it is impossible that a tricalcium-silicate and tricalcium-aluminate exists as such in Portland cement and have amply proved this in my work, published in the fall of 1910 in *Cement and Engineering News.* May be that I will be also compelled sometimes to revise the conclusions derived from my investigations, but this not earlier until it has been proved that my researches were incorrect. This has, however, neither through the works hitherto given out by Shephard, nor through the latest, most remarkable work of Keiserman, Wetzel and Jaenecke, been done, though all these as well as Shephard have given much interesting and new points."



TEST PATS SHOWING CONSTITUTION OF PORTLAND CEMENT.
The pat at the left is of tricalcium-silicate, after one day under water.
The pats in the center and at the right are of the so-called tricalcium-silicate with 2.7 and 4 per cent Al_2O_3 respectively. This was sound after 28 days under water.



CORRESPONDENCE

"Quantity System and Estimating"

In reply to several correspondents re-English System of Quantity surveying. I wish to state that the system is a good one and its workings are very simple provided the parties know what the prime cost of all materials and labor. Our contracting business in this country is so different, and we depend a good deal on our subcontractors in the various trades. Across the water, all leading contractors have their own lumber yards, brick yards, mills, plumbers, painters and plasterers, and practically all that pertains to the building business. They have also their own mechanics, working with them from one generation to another and have an office force keeping tally on all jobs and keep actual cost sheets of all labor and materials for every job. They are therefore, able to get at their system of estimating systematically with profits. Their system of quantity taking is all taken separately for each trade. Material and labor are separated, by the sq. ft. or sq. yd. and cu. ft.

The Quantity Surveyor takes out the quantities on all large jobs and he is allowed 2½ per cent of the total amount of the contract for his work; which each contractor adds to his estimate in a space left for that item. The surveyor is paid out on the first payment that comes due on the contract. The quantity surveyor guarantees his quantities and if any shortage is found he pays up like a good man. That I know from an actual incident that occurred on a large municipal building where the writer was clerk of the works, and checked up the mistake, when making his monthly statement payments. It would not pay to have many law suits, as that would put them out of the business forever, if their defects should leak out. Therefore the estimates are very carefully and accurately taken out by competent men with a full force to check up all items. The quantities are delivered to the architects by the contractors with their bids itemized and copies kept by the architects should any changes or omisssions be made. The prices in the quantities are taken and priced accordingly, added to or deducted as the case may be, which sometimes saves the owner many an expense item. This is fair for both sides.

The British government have a schedule system and price list in accordance to the regular rules of the system and their estimates are based on that schedule. If anyone is interested in the system they can get a copy of an English architect's and builder's pocketbook, which I think is published every year. This will give anyone an insight into the system and how they price materials and labor in the various government departments. This I think gives a very fair price and profits compared to what we get in this country.

Our contracting business is in a very crude state. Too much risk and rule of thumb estimating, hit or miss and guess work is very disheartening and besides the laborious lot of work with no redeeming feature about it. If a system of "Quantity Taking" could be installed in the contracting business it would be of a great benefit to all concerned. I think our Builders' Exchanges throughout the country should get together and get an office fitted up with a staff of competent men to run it and have a full set of checkers. The estimates then could be guaranteed and would suit different localities. Have a space left in the estimate for a charge of 2½ per cent on the total cost of contract to be paid to the Exchange, to pay for keeping up the expenses and to guarantee the quantities to the owner in case same is found short. When the contract is signed a copy is filed with the architect fully itemized for future use and to base all cost on any extras or omission in the contract. When an owner could see, and be convinced that he is having a square deal no honest man could have anything to say to a system like that, and the little extra he has to pay for quantities indirectly is money in his pocket in the long run.

F. R. Griffith.

Architect and Reinforced Concrete Engineer.
Los Angeles, Cal.

[Mr. Griffiths adds a postscript that he would be glad to answer any questions or make any suggestions toward formulating plans as a basis for a system of quantity surveying in this country, drawing on his experience in this work both here and abroad. The question is receiving merited attention throughout the country, and promises much in its development. —Editors.]

Sulphur Trioxide and Gypsum in Cement for Marine Construction

The article on "The Association of German Portland Cement Manufacturers" in the December Number of Cement Age, page 251, column 1, paragraph 3 from the top, contains an erroneous reference from my report "On the Influence of Various Percentages of Gypsum on the Behavior of Mortars in Sea Water." The article reads there:

"The investigation shows that quick setting cements will resist the action of sea water better than will slow setting cements."

That is not right, and does not give the meaning of my results. The investigations show by no means, that quick setting cements resist the action of sea water better than slow setting cements (even if considerable quantities of gypsum are added).

The question refers merely to the behavior of cements in sea water with various gypsum percentages, *without consideration of the time of setting,* which does not come into question in the investigation.

The investigations intended to determine whether cements with a low SO_3 content (up to 1 per cent) would resist the sea water any better than those with higher percentages (up to 2.5 per cent) as is for example claimed in the conditions of delivery for Argentina, which only allows cements with 1 per cent SO_3 for sea water construction.

Analysis of concrete slabs, made with cements of varying SO_3 content, and exposed for a long time to the action of sea water, proved that a smaller percentage of SO_3 in cement does not make it any more suitable for sea water construction.

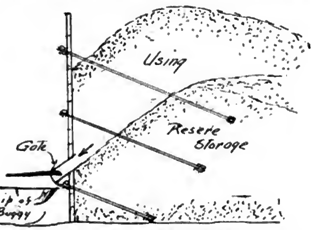
Dr. Fraum.

Berlin.

Ingenious Material Piles

Handling concrete materials behind the mixer is always a problem, and if we can make gravity do our work, we can save money.

How many times the builder will unload several carloads of gravel for his concrete job, and simply hold them up into a big pile with sloped sides. I used to do this myself, so I know. If he would only



SKETCH SHOWING ARRANGEMENT OF MATERIAL PILES.

realize that he could build a fence along one side of the pile, fitting in this fence some radial gates, he could load his wheelbarrows without any shovelling at all. What is below the line of the flow to the gate can be used for storage and reserve.

Constructor.

Chicago.

"American Concrete Association"

At the Kansas City convention of the N.A.C.U. the writer notes that the matter of adopting a more representative and comprehensive name for this body was referred to the executive committee. I am taking the liberty to suggest the name "American Concrete Association" as being especially well suited to cover the work that this organization is doing. It is definite, inclusive, comprehensive and brief.

A. E. S.

Cleveland.

Magnesium Chloride in Calcium Chloride

In regard to the possibility of the magnesium chloride contained in commercial calcium chloride being detrimental to concrete when the latter salt is mixed with the concrete to prevent freezing, while I have no particular data along this line, yet I would not hesitate to say that no danger would be incurred because of the presence of this salt.

It is a well known fact that magnesium sulphate in solution exerts a very deleterious effect on concrete because of its reaction with the calcium hydroxide in the mortar; calcium sulphate being formed which, replacing the calcium hydroxide and occupying more space, causes expansion in the body of the concrete and eventually caused disintegration of the mass.

However, when a solution of magnesium chloride is brought into contact or is mixed with a cement mortar, a simple reaction would take place between this chloride and the calcium hydroxide whereby magnesium hydroxide and calcium chloride would result. Both calcium and magnesium hydroxide being insoluble in water, the magnesium salt would merely replace the calcium salt with little or no change in volume.

Thus instead of introducing a salt which would prove injurious to the concrete, this salt would react with a component of the concrete to produce a solution of the same kind as was being added for the purpose of reducing the freezing point.

The writer has made use of calcium chloride for the purpose above named and does not feel the least uneasiness about the concrete, either now or in the future.

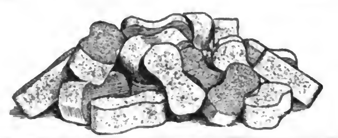
I shall be glad to hear what remarks others have to make on this subject as someone may have determined that magnesium has an injurious effect on mortar, although I do not recollect any literature on this.

Clarence N. Wiley.

Gen. Mgr. Atlantic and Gulf Portland Cement Co., Ragland, Ala.

The Convenience of Concrete In Underpinning Work

Engineering Record describes the underpinning of the unstable foundations of a steel stack erected in 1910 in the new mill building of the Union Rolling Mills Company at Cleveland, Ohio. It was accomplished by driving reinforced concrete piles to shale on two sides of the foundation, transferring the weight to I-beams, and then constructing a concrete slab under the whole foundation to prevent firing the inflammable material in to filled ground under the stack. The work is described in detail with a photograph of the base, ready for underpinning.



BRIQUETTES

MONTHLY COMPARATIVE TABLE

Imports of Portland, Roman and Hydraulic Cements.

Country	Month of Jan., 1911 Barrels	Value	Month of Jan., 1912 Barrels	Value
United Kingdom	......	......	12,600	$15,074
Belgium	......	......	1,494	1,718
Germany	158	280	942	1,185
Canada	8	13	......	......
Other Countries	744	1,019	838	1,167
	910	$1,312	15,874	$19,144
Less Foreign Cememt Exported	1,064	1,339	675	1,567
	154	$ 27	15,199	$17,577

Increase in imports during the month of Jan., 1912, as compared with Jan., 1911 . . . . . . 15,353 barrels

Country	7 Months Ending January, 1911 Barrels	Value	7 Months Ending January, 1912 Barrels	Value
United Kingdom	21,583	$ 24,430	24,661	$29,926
Belgium	71,849	89,793	4,413	5,392
Germany	37,054	51,440	52,636	84,959
Canada	379	963	71	145
Other Countries	13,534	19,258	8,141	12,603
	144,399	$185,884	89,922	$133,025
Less Foreign Cement Exported	11,274	17,802	3,026	5,809
	133,125	$168,086	86,896	$127,216

Decrease in imports during 7 mos. ending Jan., 1912, over 7 mos. ending Jan., 1911 . . . . 46,229 barrels

Imports of Portland Cement into the U. S. during January, 1912 by Districts

District	Barrels	Value
New York	1414	$ 1,918
Mobile........	20	30
New Orleans...	843	771
Los Angeles ...	997	1,351
Portland, Ore...	12,600	15,074
	15,874	$19,144

Exports of Cement

Exports of cement, month of Jan., 1911—288,120 bbls., value $409,130

Exports of cement, month of Jan., 1912—199,374 bbls., value $292,643

Decrease in exports, month of Jan., 1912, as compared with month of Jan., 1911 . . . . 88,746 barrels

Exports of cement, 7 mos. ending Jan., 1911, 1,682,424 bbls., value $2,438,434

Exports of cement, 7 mos. ending Jan., 1912, 1,757,813 bbls., value $2,604,872

Increase in exports during 7 mos. ending Jan., 1912, over 7 mos. ending Jan., 1911 . . . 75,389 barrels

NOTE—The amount of cement imported in January, 1911, was LESS than the foreign cement expotred.

CEMENT IN THE NORTHWEST

(Staff Correspondent)

THE year 1911 proved to be an exceptionally good agricultural year in the "Inland Empire" territory and it is reported that approximately $61,000,000 worth of wheat was garnered in. The season is opening up rather slow, but with this in mind, an exceptionally good year is anticipated.

During the past year the "Inland Empire" territory proper consumed approximately 600,000 bbls. of Portland cement. A conservative estimate for 1912 is 750,000 bbls.

Southern Idaho in 1911 consumed approximately 200,000 bbls. and with the large projects now launched by the Reclamation Service—especially that of the Arrow Rock Dam, which calls for 750,000 bbls. of cement—business should show a 50 per cent increase in that territory.

The prices during the past year were around $2.75, f.o.b., the cars in Spokane and this year the last quotation is $2.20, f.o.b., the cars Spokane, a reduction of 55 cts. per bbl. The reductions made have proved to be a saving of approximately $200,000 to the city of Spokane alone.

It is anticipated that the Washington Water Power Company will commence construction on their Long Lake dam this fall, which calls for about 250,000 bbls. of cement. This year is going to be a banner year in the cement business in the Inland Empire territory.

Cement Merger in Sight

Fifteen cement companies in the Missouri, Kansas, Oklahoma and Texas field are involved in a possible merger. The name of the merger company would probably be the Central Portland Cement Company of West Virginia with an authorized capital of about $45,000,000. The men active in the negotiations are: L. S. Mitchell, St. Louis, treasurer of the Iola Portland Cement Co.; Adam L. Beck of the Oklahoma Portland Cement Co.; Frank E. Tyler of the Dewey Portland Cement Co.; Geo. E. Nicholson, president of the Iola Portland Cement Co., and A. Steinmetz of the Western States Portland Cement Co.

For some time the necessity for such a proposed merger has been clearly evident, and negotiations have been under way for some time. The matter is still unsettled and nothing can be stated definitely covering the detailed plans which a merger of the companies would be based on. One thing is certain, and that is that such a combination would relieve a very adverse situation.

These cement companies are in the merger:

Iola Portland Cement Company, United Kansas Portland Cement Company, Kansas City Portland

Cement Works, Altoona Portland Cement Company, Great Western Portland Cement Company, Monarch Portland Cement Company, Ash Grove Lime and Portland Cement Company, Western States Portland Cement Company, Fredonia Portland Cement Company, Oklahoma Portland Cement Company, United States Portland Cement Company, Texas Portland Cement Company, Dewey Portland Cement Company.

The United Kansas Portland Cement Company owns three subsidiary operating plants at Iola, Neodesha and Independence, Kansas.

Clay Interests "Invest" in Cement Tile Machine Rights

It has recently come to light that the rights to use the Thomas glazed cement sewer pipe machine in the State of Washington have been brought up by the clay pipe interests. Evidently their campaign to discredit the use of concrete sewer pipe by circulating broadcast literature "knocking" cement pipe has not accomplished its purpose in that part of the country and it has become necessary for them to resort to still other means for preventing the use of cement pipe. On account of the high cost of vitrified clay sewer pipe in the west, machine-made cement sewer pipe have been used extensively since bell end sewer pipe machines were put in operation in that market.

The purchase of the territorial rights of one such machine will not materially discourage the manufacture of this kind of sewer pipe as there are several of these machines on the market which will undoubtedly be installed.

Cement in the Northwest Territory

The manufacturers are represented in the Spokane territory at this time only by the Inland Portland Cement Company, but the International Portland Cement Company are constructing a mill at Trent, a few miles out of Spokane and anticipate being in the market this fall. The Orofino Portland Cement Company has been organized to develop properties at Orofino on the Clearwater branch of the Northern Pacific, so that with the two new firms desirous of entering the field, much attention is being paid to advertising the uses of cement on concrete construction to stimulate the trade and create a further demand. About 750,000 bbls. of cement will be used in the "Inland Empire" during 1911.

The Königshof Portland cement plant uses a vacuum operated packing system, in which the empty bag or barrel is drawn upon a scale within an enclosed cell. The cement is drawn into the vacuum hose by suction and discharges into the bag or barrel, till the latter is filled, when the cement supply is cut off automatically and the full bag thrown out of the cell.

The annual statement of the Canada Cement Co. for the year ending December 31 shows net profits of $1,382,038, which, after the payment of bond interest and preferred dividends, leaves a balance of $278,898, or slightly over 2 per cent. on the common stock. President Edwards says that one of the chief troubles of the year was the inability of the Canadian railroads to handle the company's products.

The Portland Cement Construction Company of Canada, subsidiary to the Associated Portland Cement Manufacturers (Ltd.) of London, England, has purchased 100 acres on Saanich Arm, 10 miles north of Victoria, and will establish there a $1,000,000 cement works with 2,000 barrels daily capacity.

PRACTICAL FIRE TEST OF A REINFORCED CONCRETE BUILDING

On December 15 last a fire broke out in the unfinished reinforced concrete building of the Swift Canadian Company's building, at Fort William, Ontario. As described by *Engineering News*, the concreting was being carried on through the very cold weather common in that part of Canada in December and the usual precautions for heating the interior of the building and the concrete were observed. On Dec. 7 the columns supporting the top floor and the top floor slab were cast, this being the last concrete work to be done. Salamanders were kept lighted in the two floors thereafter to preserve a high temperature for the setting concrete, and on December 15, eight days after the last concrete was laid, a pot of pitch caught fire from one of these salamanders and the whole timbering was soon destroyed.

A FIRE TEST IN A CONCRETE FLOOR

The concrete was damaged only by a slight surface spalling and the slabs and columns stood up under their load without any apparent crack or sag, although the concrete had had only about eight days' set in very cold weather.

The building was designed by C. A. P. Turner, using the Turner system of "mushroom" flat slab construction, and was built by J. & W. A. Elliott Co.

The Ruggles-Coles Engineering Co., 50 Church street, New York City, and McCormick Building, Chicago, have appointed the London Concrete Machinery Co., London, Ont., as their agents for the sales of the Ruggles-Coles portable dryer and heater for road work.

RECENT PUBLICATIONS

THE ELEMENTS OF STRUCTURES. By G. A. Hool. First edition. Published by McGraw-Hill Book Co., 239 West 39th St., N. Y. C. 6 x 9 in. Cloth bound. 188 pages, illustrated.

ECONOMICS OF CONTRACTING. By Daniel J. Hauer. Published by E. H. Baumgartner, Monadnock Block, Chicago, Ill. 5½ x 8½ in. Cloth bound. 269 pages, illustrated. Price, $2.50.

CRAFTSMAN BUNGALOWS. By Jud Yoho, Bungalow Specialist. Published by the author, Seattle, Wash. 10 x 6½ in. Paper bound. Illustrated. Price. 50 cts.

THE USE OF CONCRETE ON THE FARM. U. S. Department of Agriculture. Prepared by the Office of Public Roads, Washington; Government Printing Office. 6 x 9 in. Paper bound. 23 pages, illustrated.

THE EVERYDAY USES OF PORTLAND CEMENT. Presented and published by the Associated Portland Cement Manufacturers (1900) Ltd., Portland House, Lloyds Avenue, London, E. C., England. 5½ x 8½ in., 348 pages, illustrated.

SEWAGE DISPOSAL PLANTS FOR PRIVATE HOUSES. Iowa State College Engineering Experiment Station. By A. Marston and F. M. Okey, Ames, Iowa. 5½ x 8½ in. Paper bound. 44 pages, illustrated.

THE CEMENT GUN. By William A. Jordan. Special reprint. The American Society of Engineering Contractors, 13-21 Park Row, New York City. 6 x 9 in. Paper bound. 30 pages, illustrated.

TECHNOLOGIC PAPERS OF THE BUREAU OF STANDARDS No. 5. S. W. Stratton, Director. THE EFFECT OF HIGH-PRESSURE STEAM ON THE CRUSHING STRENGTH OF PORTLAND CEMENT MORTAR AND CONCRETE. By Rudolph J. Wig, Bureau of Standards. 7 x 10 in. Paper bound. 25 pages, illustrated.

STEEL AND REINFORCED CONCRETE IN BUILDINGS. By Edward Godfrey, M. Am. Soc. C. E. Published by the author. 6½ x 4½ in., 156 pages; leather bound; illustrated. Price, $2.00.

Mr. Godfrey states that his book is designed to meet the requirements of those who, designing upon a small scale, cannot afford to employ an engineer, but only in his introduction does he indicate that the work is not intended as a "vade mecum." A number of the tables and diagrams are very useful and some of them are taken from the author's other books. In regard to their accuracy the reviewer has been unable, owing to limited time to check them in any way, but Mr. Godfrey's conservative stand, particularly upon reinforced concrete and steel structures would tend to insure the safety, but possibly not the economy of the design based upon them. As a guide to hurried work they furnish a safe basis, but discretion, as the author indicates in his introduction, is necessary in their use.

Like many other books of designing tables, they are not, and cannot be made "fool proof." No writer can foresee the warped construction that may be placed upon his work, nor the unintelligent uses that may be made of it.

The book is good value to those for whom it is intended and hence is an addition to a useful arsenal of facts.

Standard Stucco Specifications

A suitable specification for stucco has been a much-mooted subject and when the Metal Lath Manufacturers of the United States associated themselves for the purpose of working out the problems of the metal lath industry, stucco construction was one of the first things taken up. After over six months of consulting with authorities and conferring with architects, contractors and manufacturers, a typical specification to offer to architects was finally decided upon and this will be distributed among the architects of the country as a composite of the best ideas in the United States on stucco construction.

The specification is in convenient form and should be of much assistance to architects and builders in preparing and executing stucco work. Copies of the specification can be received by addressing the Associated Metal Lath Manufacturers, Youngstown, Ohio.

Automatic Sprinkler Bulletin

This quarterly publication, devoted to the interests of fire prevention from the standpoint of the automatic sprinkler, contains a great deal of detailed information regarding the actual operation of sprinklers in cases where fires call them into action. The January number is a particularly interesting one, carrying with it digests of the reports of the Chambers of Commerce of Rochester, N. Y. and Boston, Mass., both of which declare very strongly for the installation of automatic sprinklers, particularly in cases where fires would endanger large numbers of lives, or would threaten to spread into a conflagration. This *Bulletin,* which is full of pithy items, partially culled from the reports above mentioned, is published by the General Fire Extinguisher Company, Providence, R. I. It will well repay careful reading by anyone whose interests are at any time liable to be threatened with destruction by fire, and will be sent regularly to anyone who desires it.

Form Work

Lumber for forms should be free from shakes and rot and as free as possible from knots. Knots will show on the finished surface of the concrete and of course will weaken lumber which is used for supporting forms.

Partly dry lumber is better for forms than kiln dried, which will swell and bulge at the joints. and better than green lumber, which will shrink if not kept wet so as to leak badly when the wet concrete is placed.

Concrete Residence Construction and the Seventh Annual House Building Number

INTEREST in home building is practically universal, and the possibilities in concrete for this use have made a wonderfully wide-spread appeal. From every side, the demand comes for accurate up-to-the minute information on concrete for the home, and to meet this demand, the May issue of CEMENT AGE has, annually since 1906, been devoted almost entirely to the problems of concrete house building.

The problem naturally divides into structural and architectural features with the minor utilitarian side lines, as it were. In regard to structural features, the exterior wall is usually the first factor considered. The questions received in the daily mail involve the comparative value and cost of monolithic, unit, or stucco treatment; and at the present time, while the *real* value of each type of construction has been demonstrated, the *comparative* value still offers a field for discussion. And even in considering each type analytically, the comparative value of different methods and means offers many interesting problems. For instance, in monolithic construction, what is the relative value of steel or wooden forms; of solid or hollow walls? In unit wall construction, which includes concrete brick, block, tile or larger units, each means offers distinct and individual values.

The different technical and practical questions involved in making walls absolutely "damp-less" are of interest. Should furring be used, and if used—how? Ideal wall construction is the goal, and of one point only are we sure, and that is that concrete is *the* material to use. *How* to use it is open to discussion. Some of the other questions submitted to us are:

"What is the best and cheapest fireproof floor construction?"

"Are cement or terrazo wearing surfaces in general use, and are they satisfactory?"

"What have been the developments in reinforced concrete roof construction?"

"Is an absolutely fireproof stairway structure within reach of the average home builder?"

The general question, *"what is the average cost?"* could well be appended to any one of the above, for in practically every case, cost is a very essential factor.

The architectural treatment of exterior and interior surfaces brings in many questions. Different methods of treating the surface, the use of decorative tile, different surface coatings, tintings, etc., are all of interest. Concrete garden furniture and accessories have had a wonderful development.

For the utilitarian and every-day domestic requirements, concrete is rapidly demonstrating marked efficiency. Sinks, tubs, cold storage chests, and other accessories are made in concrete, and the development is only started. These are a co-ordinate and rather essential development.

Every man is, in one way or another, a *home builder*, and the May issue, given over almost entirely to this most interesting question, will be essentially a *Conference* number, in which the regular editorial pages, with the Consultation and Correspondence Departments present the cumulative experience of home builders the world over.

For this, as for every number, CEMENT AGE invites questions and discussions on the many wonderful developments and potential endeavors in concrete construction, which are making this material the wonder of the Twentieth Century.

In the above, we have briefly outlined some of the problems in the house building field to-day. Time and effort alone will solve them. CEMENT AGE is trying not only to record from time to time the successful solutions of many problems, but, by offering an exchange of the best thought and endeavor, is really helping the work. In the last analysis, it is co-operative effort. CEMENT AGE, we believe, can help you, and you, we know, can help CEMENT AGE. We are all working together toward better construction, which means *concrete* for every structure, as well as for Concrete Homes.

Respectfully,

April 1, 1912. THE EDITORS.

CONVENTION AND EXHIBITION NOTES

WE have been so used to the big exhibitions and record-breaking attendance at the New York and Chicago Shows, that the smaller show and gathering at Kansas City was on the surface, disappointing. A careful summing up of the situation shows, however, that the Kansas City Show was all in all, a success.

In the first place, the show itself was good, thoroughly good. The exhibits were all very carefully prepared, and the booths carefully attended, so that the visitors met with a good reception everywhere.

The convention of the National Association of Cement Users brought to the city many concrete engineers and contractors. These men made a notable addition to the attendance at the show, so that on every hand, exhibitors, even facing the fact of a numerically small attendance, expressed themselves as more than satisfied with results.

Bad weather, as at the Chicago show, pulled down the attendance. Merited publicity which the show should have had in the daily papers, was hampered by Kansas City conditions, in which politics, clay products and "unreasonable" influence were all involved.

The work of the *Post* and the *Journal* in publishing accounts of the Show and the Cement Users' Convention should be commended here.

Among the new exhibits of interest was that of the Trusswall Mfg. Co. of Kansas City, who furnished for the Western Association of Cement Manufacturers the entire space at the end of the hall. The turned concrete columns,* forming pergola and entrance way were very good. Among the new mechanical appliances was a tool to twist up wire in wall centering work, a cast segmental column head, new block plant equipment, and other interesting developments.

Figures covering the attendance are not available yet, but will probably show less than what was expected, due to several unfavorable conditions. The show, however, brought home to Kansas City a striking lesson in the development of concrete.

For rough concrete work it is generally best to use lumber for sheathing that is dressed at least on one side and two edges to make the boards of uniform width so that they will fit together. Even if the appearance of the concrete is of no account, the smooth form surface will reduce the labor of removing and cleaning the forms.

*This process was described in CEMENT AGE for October, 1911.

DAVID D. DRUMMOND

David D. Drummond, one of the early cement manufacturers in the middle west, died in Chicago, March 9th. His connection with the Chicago Portland Cement Company, of which he was latterly vice-president and manager, covered a period of thirteen years. An enthusiastic and untiring worker, Mr. Drummond was always a prominent figure at the meetings of the Association of American Portland Cement Manufacturers and during his entire lifetime he was likewise actively interested in the work of the National Association of Cement Users and kindred bodies. For the past few years he had been in poor health and was occasionally compelled to sojourn in the South. Recently his health showed some improvement, admitting of a brief trip to Panama, while his presence at the recent Chicago Cement Show was very gratifying to his wide circle of friends. Born in Scotland, Mr. Drummond had lived in this country since boyhood. He died in his fifty-second year and is survived by a widow and three sons, Douglas, Ralph and Kenneth. The funeral service was held at the residence of Norman D. Fraser, 2928 Washington Boulevard, Chicago, on March 11th, the Rev. H. J. Ridings of the First Congregational Church, La Salle, Illinois, officiating. The pallbearers being J. U. C. McDaniel, Herbert S. Turner, D. Ross Fraser, J. N. McGill, F. H. Cull and R. Crawford, all of the Chicago Portland Cement Co.

CONCRETE PAVING IN EIGHT CITIES

Under this caption the *Municipal Journal* of March 21, gives an interesting summary of concrete paving in Kansas City, Liberty, Mo.; Marshalltown, Sioux City, Ia.; Bozeman, Mont.; Bemidji, Minn.; Appleton, Wis., and Greenville, Ill. One and two-course construction and expansion joints are considered. It is a comprehensive article contributed by the city engineers of the towns named. The following is an extract relating to pavements in Kansas City:

From April 17, 1911, the beginning of the present fiscal year, to March 10, 1912, Kansas City laid 46,029 square yards of plain concrete pavement on streets at a cost of $56,559.78, a little less than $1.23 per square yard. During the same period 28,052 square yards of this pavement were laid on alleys at a cost of $38,645.57, or approximately $1.38 per square yard. On streets the total amounted to 3.3 miles, on alleys 3.4 miles. In addition to the above quantities contracts have been awarded during the past winter for concrete pavement on streets to the amount of $79,067.82, at an average price of $1.04 per square yard, but the work has not been completed. With this work in view I believe the coming year will nearly double the amount of concrete pavement laid in 1911. In 1910 scarcely any of this class of pavement was constructed on streets.

The lowest price paid for concrete pavement during 1911 was $1.02 per square yard; the highest price $1.47. Recent contracts have been let for as low as 96c. per square yard. The price of cement has varied in 1911 from $1.30 to 88c. per barrel; sand averages $1 per cubic yard delivered, and crushed rock, $1.35. All contracts include the cost of sub-grading and provide for payment in special tax bills issued against the abutting property, which the contractor must dispose of at a discount ranging from 7 per cent to 10 per cent., or carry himself.

COMPETITION FOR POURED CONCRETE HOUSE DESIGNS

THE Blaw Steel Centering Co., of Pittsburg, Pa., announce a competition for the best plans and specifications for small concrete residences. The prizes are as follows:

\$100.00 for the best set of plans.
75.00 for the next best set of plans.
50.00 for the next best set of plans.
25.00 each for the next best three sets of plans.

Designs must be submitted by May 15, 1912. The competiton will be conducted under the rule of the American Institute of Architects and is open for everybody. The object of the competition is to have presented for the consideration of owners suggestive designs that will give the greatest value for the expenditure, and also new ideas that will tend to stimulate the construction of poured concrete houses.

General Conditions: Foundations and outside walls must be of poured concrete, reinforced where necessary. Floors, ceilings, partitions, roofs, porches and stairways may be of concrete or of any other material, as the judgment of the designer may determine.

While the house may be of any design, suitable for any location, whether on level or sloping ground, and adapted to any climate and while such matters as furring and determining the number of stories are left entirely to the designer, the total cost of the house, ready for occupancy, must not exceed \$3,000.

Specifications must accompany the drawings. They must briefly describe the method of construction adopted for partitions, floors, stairs and roof; the method of placing doors and window frames, flues and pipes; the heating, lighting and plumbing systems; and the exterior and interior finish.

The contestants must enclose with plans and specifications a detailed estimate of cost, in which the following specified unit costs shall be assumed for the concrete work:

Reinforcing steel, in place, per lb.......	\$ .03
Concrete in place, exclusive of forms, per cu. ft..........................	.20
Form cost, where steel forms are used, per sq. ft..........................	.01½
Form cost, where wooden forms are used, per sq. ft....................	.15

Estimates on other parts of the work must specify the locality where the prices will be found to apply.

Following the award of the prizes, the plans of the successful contestants, with names and addresses of the designers, will be published in a booklet, which will be given wide circulation among prospective builders to encourage the construction of concrete houses.

The interest in concrete house work has always centered to some extent around the monolithic poured structure, and such a competition, based on such work alone, can not but add considerably to the data and study of concrete houses.

The second annual New York Architecture and Engineering Exhibition, which was to be held from March 25 to 30, has been merged with, and will be held in conjunction with the Fire Exposition, October 2 to 12, constituting a department of fireproof construction and safety building equipment.

THE RAIL STEEL BAR MANUFACTURERS' ASSOCIATION

A meeting of the representatives of steel mills whose product is rolled from rails into bars, shapes and special sections, was held at the La Salle Hotel, Chicago, March 9. A permanent association was formed to further the interests of members by promoting the publicity and use of their product with particular reference to bars for reinforcing concrete. Of this commodity all of the mills represented are large producers.

The organization will be known as the Rail Steel Bar Manufacturers' Association, and the following officers were elected at the initial meeting: Pres., Edward E. Hughes, Franklin, Pa.; Vice-Pres., J. G. Joseph, Buffalo, N. Y.; Sec'y and Treas., A. S. Hook, Chicago, Ill.

During the past few years the questions involved in the selection of reinforcing steel have been many, and little understood. There has been much misinformation, and a lack of comprehension of the real factors involved. The association is formed mainly in an endeavor to present the situation broadly, with special reference to rail steel reinforcing material. Standard specifications covering this material will be adopted in the near future. Such an association has a promising field of work in developing better standards which make for better work.

SUCCESSFUL GIRDERLESS CONSTRUCTION

The Sharples building at the corner of Washington Boulevard and Jefferson street, Chicago, was designed by the Condron Co. of Chicago and built on the flat ceiling type of the "Akme" System. The columns are spaced 18 ft. x 17 ft. 5 in. The floor slabs, 8 in. thick, are designed for a live load of 225 lbs. per sq. ft.

The floors were successfully tested, under the direction of the Building Department, with a test load of 550 lb. per sq. ft., covering two entire adjacent panels. Under this load of 344,000 lb. or 172 tons, the maximum deflection at the centers of the panel, after three days, was 22-100 in. equal to 1-1400th the diagonal span, or 57 per cent. of the deflection allowed under the Chicago ordinance for girder and beam construction.

The columns are uniformly 24 in. in diameter from the basement to the roof. The first floor was poured on September 21 and 22, and the tenth floor on December 21 and 22, 1911; hence the structure was erected at the rate of one story every 10 days, during the fall and winter. All the concrete materials were heated by live steam during the cold weather and the concrete protected from freezing.

The Inland Steel Co. announces, effective February 15th, the appointment of O. P. Blake as Asst. Gen. Man. of Sales, with headquarters at St. Louis, in charge of southwestern territory. F. R. Meyer, Jr., has been appointed District Sales Manager at St. Louis and J. B. Sharp District Sales Manager at Kansas City. The Inland Steel Co., recognizing the importance of Kansas City as a market for their products, will open an office there February 15th. Room 511 R. A. Long Building.

PATENTS

The following patents relating to cement and concrete have been granted by the United States Goverment during the past month. Illustrations and specifications of any of the patents mentioned in this Department will be forwarded on receipt of 25 cts. to cover costs. Address Royal E. Burnham, 857 Bond Building, Washington, D. C.

1,017,118. Reinforcement for concrete roadways. Avila Thomas, Detroit, Mich., assignor to Thomas Steel Reinforcement Co., same place.

1,017,175. Floor or like structure. Ferdinand Schar, Lucerne, Switzerland.

1,017,211. Method of making cement. William B. Hill, Kansas City, Mo.

1,017,346. Expansion joint for concrete roadways. Avila Thomas, Detroit, Mich., assignor to Thomas Steel Reinforcement Co., same place.

1,017,386. Building construction. Lewis K. Davis, New York, N. Y.

1,017,622. Subaqueous tunneling and excavating. Russell L. Dunn and Leon M. Hall, San Francisco, Cal.

1,017,720. Concrete-mixing machine. Harris Morgan Whitcomb, Albany, Wis.

1,017,876. Machine for molding concrete. Frank F. Landis, Waynesboro, Pa.

1,017,912. Manufacture of slag cement. John Gustaf Adolf Rhodin, London, England.

1,017,913. White hydraulic cement and process of making the same. John Gustaf Adolf Rhodin, London, England.

1,017,917. Combination block and tile machine. Joseph E. Runner, Dugger, Ind.

1,017,922. Tile-cutting machine. James L. Sheron, Marion, Ind.

1,017,947. Railroad-tie. Jacob Booth, Reynoldsville, Pa.

1,018,018. Clip used in concrete construction. Joseph H. Straus, Jr., Baltimore, Md., assignor of one-half to Raymond H. Williams, same place.

1,018,072. Post-mold. John T. Neeley, Chesterton, Ind.

1,018,396. Culvert-mold. Oley L. Ledington and Julius N. Sandell, Marquette, Kans.

1,018,404. Apparatus for washing stone and for mixing macadam and concrete. William Henry Baxter, Harrogate, England.

1,018,490. Hanger-support for concrete floors. Eric E. Hall, Chicago, Ill.

1,018,488. Concrete scow. John Thomas Gorsuch, Baltimore, Md.

1,018,634. Apparatus to be used in constructing concrete walls, piers, etc. John W. Seaver, Cleveland Heights, and James E. A. Moore, East Cleveland, Ohio; said Moore assignor to said Seaver. Mary T. P. Seaver executrix of said John W. Seaver, deceased.

1,018,754. Post. Arthur W. Ford, Quincy, Mass., assignor to Henry T. P. Bates, same place.

1,018,779. Concrete-mixer. Theodore Rauschenbach, Evansville, Ind.

1,018,780. Machine for forming and finishing concrete and cement curbs and gutters. Theodore Rauschenbach, Evansville, Ind.

1,018,872. Reinforced-concrete burial-vault. William B. Bussard, Huntington, Ind.

1,018,902. Tie and rail-fastener. Harry L. Heacox, Derry, Pa.

1,018,951. Sand-drying furnace. Frederick W. Adlof, New Kensington, Pa.

1,018,979. Point for concrete piles. Adolf Mast, Tempelhof, Germany.

1,019,028. Pipe-tamper, etc. Pickering Dodge, Falls Church, Va.

1,019,034. Expanded metal. William D. Forsyth, Youngstown, Ohio, assignor of one-half to Alexander M. Neeper, Pittsburgh, Pa.

1,019,042. Pile. August Gundersen, Christiania, Norway, assignor of one-half to Olaf Hoff, New York, N. Y.

1,019,228. Building-block. Edward L. Dobbins, Jewell, Kans.

1,019,326. Concrete wall construction. Sylvester Higgins, Jersey City Heights, N. J.

1,019,414. Manufacture of tiles. Charles H. Bellamy, Philadelphia, Pa., assignor, by direct and mesne assignments, to Concrete & Clay Products Company.

1,019,505. Pipe-machine. William McConnell, Sioux Falls, S. D.

1,019,539. Cement-finishing machine. George W. Sharp, Enid, Okla.

1,019,561. Cap and base for fireproof columns. John J. Tresidder, New York, N. Y., assignor to American Column Company, Brooklyn, N. Y.

1,019,598. Cement-mold. Horace W. Clark, Mattoon, Ill.

1,019,604. Hanger for cement posts. John S. Culley, Louisville, Ky.

1,019,737. Concrete-mixing machine. Carl O. Hoglund, Crookston, Minn.

1,019,816. Fence-post and fence-fastening. Alexander J. McGavick, Chicago, Ill.

1,019,817. Fence-post and fastening. Alexander J. McGavick, Chicago, Ill.

1,019,917. Concrete-mixer. Arthur W. Ransome, New York, N. Y.

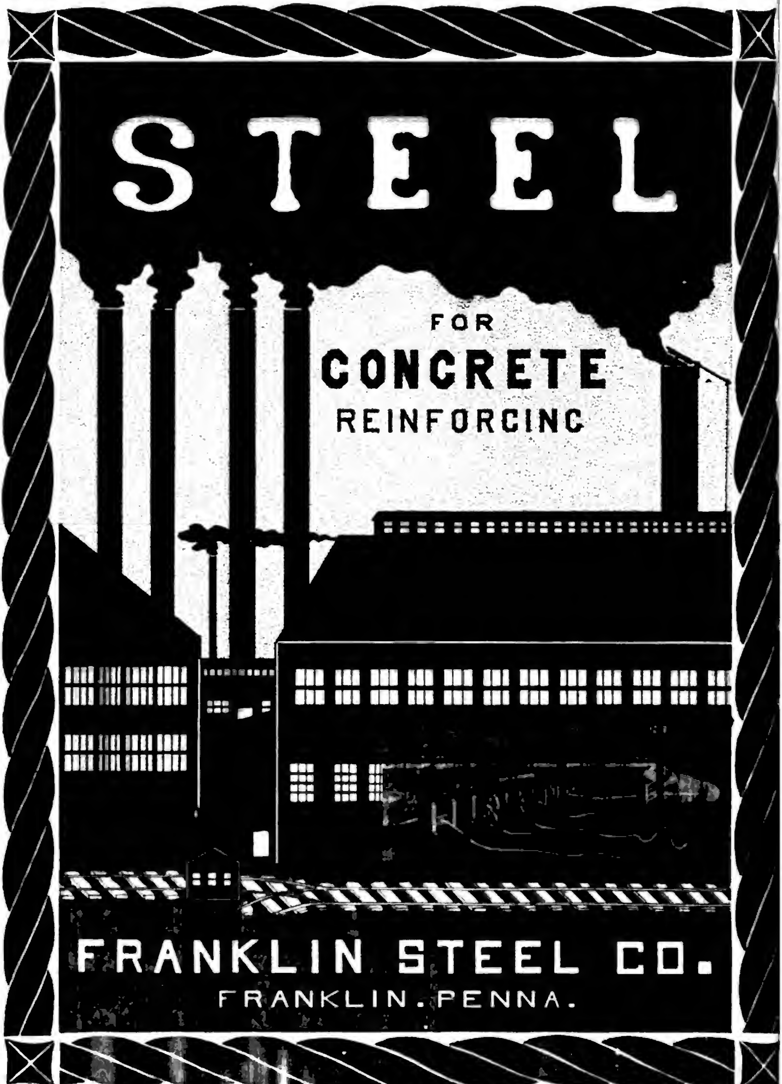
1,019,918. Process of making concrete pipe and tile. William A. and Blake O. Reynolds, Asheville, N. C., assignors of one-half to Paul H. Reynolds, same place.

1,019,997. Stone-crushing machine. Edgar B. Symons, Fort Wayne, Ind., assignor, by mesne assignments, to Smith & Post Company, Milwaukee, Wis.

1,020,005. Mold for making concrete chimneys. Charles H. Witthoefft, St. Louis, Mo., assignor to Witthoefft Collapsible Concrete Forms Company, same place.

1,020,164. Clamp for concrete-forms. Arthur H. Symons, Kansas City, Kans.

1,020,279. Concrete-mixer. William M. Goss, Cheyenne, Wyo.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Cement Age

JUN 1912

A MAGAZINE DEVOTED TO THE USES *of* CEMENT

with which is combined

Concrete Engineering

VOL. XIV MAY, 1912 NO. 5

Concrete Houses *for* Everybody

THIS NUMBER contains a symposium on the subject of the concrete house of moderate cost. The writers who have contributed to this symposium are men who have had the widest experience and are best fitted to discuss this vital subject.

Is concrete economical for small residence construction?

Does it pay the man of limited means to build a fireproof house?

What advance has been made recently in methods of building concrete houses?

These questions and many more of supreme importance to the prospective builder, the architect and the contractor are answered in this number. It also contains photographs and plans of low-cost houses and

Concrete Bungalows

Edited by ROBERT W. LESLEY, Assoc. Am. Soc. C.E.

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Established 1904, with which is combined

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VOL. XIV MAY, 1912 No. 5

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THE RESIDENCE OF COLONEL WILLIAM CHANTLAND, WASHINGTON, D. C.

This frontispiece presents the accomplishment of an ideal. Three years ago, a model of this house was exhibited at the International Congress on the Prevention of Tuberculosis, and was awarded the first prize. The design is essentially directed toward clean, hygienic living, and real simple comfort, and has been carried out wonderfully with reinforced concrete. The successful and economical erection of this house marks a distinct advance in home building.

CEMENT AGE with which is combined CONCRETE ENGINEERING

A Monthly Magazine Devoted to the Uses of Cement and Concrete

VOL. XIV MAY, 1912 *No. 5*

THE COST OF CONCRETE DWELLINGS

Benjamin Howes, enthusiast on the subject of concrete, and a pioneer in the construction of some of the most attractive concrete houses in the country, has, according to a recent article in the *Saturday Evening Post,* arrived at the conclusion that the concrete house is hardly worthy of consideration unless one has $25,000 or more to spend in its construction. Mr. Howes discusses the subject of building in detail, but this is the gist of his article so far as it pertains to concrete. It would be a sad ending to the cheap concrete house movement if Mr. Howes' conviction could be sustained. Taken literally it would mean that all effort to evolve and construct durable, fire-resisting and sanitary houses at moderate cost is futile, for everybody knows that the counterpart of the true concrete house could not be built of other materials at anything like the same cost, that is to say, with foundations, walls, floors, partitions and roof of indestructible and non-combustible material. Each of these features is perfectly feasible in concrete but impracticable if not prohibitive in cost in the case of other materials.

The difficulty Mr. Howes will encounter in seeking to sustain his position lies in the fact that excellent concrete houses have already been built at far less than the sum he specifies. It is true that they may not consist of concrete throughout, but their cost in some cases is so far below Mr. Howes' figure that the use of concrete for every structural detail would still leave the cost thousands of dollars under his estimate. For example, we may refer briefly to a concrete house described in this journal in 1910.

The dwelling is a double house, 59x36 ft., and is two and a half stories high. Each side contains a living room, dining room, kitchen, pantry, six bedrooms, bath room, laundry and large storerooms. In the basement each house has a shower bath and dressing rooms. Separate hot water plants were installed, with electric light fixtures and gas ranges, making a thoroughly modern and convenient dwelling. The walls of the house, and likewise the party wall, are of solid concrete from ground to roof. The entire ground floor is a concrete monolith. A flooring of wood was placed over the concrete basement floor. The entrance porch, with massive columns and beams, is solid concrete, including floor, steps and balustrade. The porch is 9 ft. wide and 8 ft. 6 in. above the sidewalk, having a return at one side. Exterior concrete panels were decorated with Moravian tiles. The porch and massive concrete chimneys, the latter carrying open fireplaces in the living rooms, are an integral part of the house. The shower baths and adjoining furnace rooms are solid concrete. The floors of the living rooms and bedrooms are of wood, and the walls of these compartments have been furred and plastered. The trim throughout is chestnut in dull finish. We feel that this describes a very substantial house. It has been perfectly satisfactory in every respect. *This house cost less than* $10,000.

Thrown into one it would make a dwelling far larger than the average house. To have done this would have eliminated duplicate heating plants, stairways, some of the partitions and the party wall. We would have had, however, a larger dwelling than most families require. Eliminating one side altogether, the saving would have been much greater, but at the same time resulting in a house entirely suitable for the average family. Indeed it would be a better house than the average dwelling. Reduced to half the present size, the saving would have represented approximately $3,000. Had this been applied to concrete floors and stairways in the upper stories, we would have an indestructible, fire-resisting and true concrete house costing $15,000 less than Mr. Howes' lowest estimate. This house may be regarded as typical. The conditions for economical construction were not unusual. Other concrete houses have been built for five and six thousand dollars where the income of the owner would not warrant a greater outlay. We believe it entirely feasible to obtain for very small families attractive concrete houses that would not cost over $4,000. In the interest of the working classes effort is being made to evolve through standardization of shapes solid concrete houses that shall not cost over $1,200. Of course, if Mr. Howes has in mind a very large house, providing such room and conveniences as are usually demanded by people of great wealth, the subject is scarcely worth dis-

cussing from the standpoint of either cheap or costly construction as they affect the average man, for the latter could not maintain such an establishment if presented to him. It is essential that we should not lose sight of the fact that cost and maintenance should correspond with the owner's income, and granting this, the problem confronting us is to determine whether it is possible to provide a comfortable, convenient and attractive concrete house for one having an income of about $2,000. We contend that it is not only entirely feasible but has already been accomplished. We hold further that economy in concrete dwelling construction has been developed in a superficial way. It comprehends at present not the true concrete house but merely a house with concrete walls, in other respects a duplicate of thousands of houses built of other materials. The extreme of simplicity in concrete construction is yet to come.

It is a matter of regret that Mr. Howes did not go more into detail, for we suspect that the impression made by his article was not exactly the thought he intended to convey. He may have had in mind houses of greater dimensions than his critics have discussed, but in any event he would probably be among the last to discourage a movement of such world-wide and vital importance. On the contrary the concrete houses he has built, the beautiful cement panels and architectural details he has designed, all bespeak the architect interested in true progress and economy. But whatever his purpose or conclusions, the house described above proves beyond any question that a thoroughly satisfactory concrete dwelling may be built away below the cost he regards as the minimum for this type of dwelling. In addition to this readers will find in subsequent pages the testimony of experienced architects, engineers and builders, which goes to prove that Mr. Howes' figures are entirely too high.

"FIRESTONE" OR BRICK CONCRETE

"BRANDSTEIN" is a concrete in which the aggregate is the waste fragments around a brick or clay tile plant. It is mixed wet, and the texture of the clay product absorbs some of the neat cement, producing a material with remarkable fire-resisting qualities. This "brandstein" or "fire stone" is used with much success in chimney construction. The Sage Foundation Homes Co., at Forest Hills, New York, have purchased by the carload waste brick from the brick yards to crush for use as concrete aggregate, and particularly pleasing results have been secured in exposed surface finishes. In this connection, a correspondent describes the extent to which the manufacture of pre-cast chimney units has been undertaken by European brick and tile plants. American plants, with a desire to conserve every scrap of material, will consider this with much interest, and we venture to say that the time may not be very far distant when our brick and clay tile plants will be manufacturing and advocating *concrete* chimneys. Rather an interesting situation, to say the least.

CONCRETE INVINCIBLE

NOW that the building season has begun, it is interesting to review the situation as it pertains to the status of reinforced concrete. A year ago a very serious fight was being waged against concrete by competitive interests. The advocates of reinforced concrete were too busy developing their industry to give serious attention to adverse criticism, being content to note and rectify mistakes or bad practice without replying to their critics beyond setting forth the true state of affairs involved in the few failures that have taken place. There was no concerted effort on the part of concrete interests to defend their material against the organized endeavor of the enemy. The latter spent money liberally, and a vast deal of space was occupied in their various publications to show that concrete is a dangerous and unsafe material. The result has been a waste of time and effort. The opponents of concrete found not only an unsympathetic audience but were confronted with the humiliating fact that many of their own people were using concrete liberally in the construction of buildings designed for the manufacture of competing products, for example, large brick plants and lumber mills. The advocates of concrete do not, however, take great credit for the present state of affairs. The development of the concrete industry is due to the superior advantages of the material itself. The advantages have been manifest wherever concrete has been used. It is unnecessary to go into details concerning the vast quantity of concrete used in engineering enterprises and the construction of buildings, especially of the factory type. Perhaps the most significant and satisfactory progress of the past twelve months concerns the changed attitude of many architects and owners of buildings upon the subject of fireproof construction. They are beginning to understand that non-combustible materials, such as iron and steel, may, in themselves, mean nothing from the fire-resisting standpoint, unless adequately protected, and that the best of all materials in this field is concrete. They are pretty well assured that the highest type of fire-resisting construction is reinforced concrete for the building, with protected openings and other appliances as a safeguard against destruction of contents and spread of flames. The refusal of many owners of reinforced concrete buildings to carry insurance on the structure itself has been a pronounced factor

in promoting public confidence in the material. Thus there has been no retrogression in the more familiar uses of concrete, while distinct progress has been made in the direction indicated. In the light of what has taken place it is not surprising that efforts to retard the use of concrete are becoming more feeble and scattered. In brief, the fight is already lost. In this contest, as in a physical sense, little satisfaction or profit has been derived from butting into concrete.

CONCRETE AND THE HOME BUILDER

EVERY one of us wants a home and for its building we must use materials and methods which stripped of artificial sham offer the factors that make for cleanliness, permanence, safety and beauty. Cleanliness in a well known axiom comes next to something else. Our homes should be both.

A home, the family shelter, is the unit in our social life. The home structure being elementally a protection from the weather must logically be built of *weather-resisting materials*. Consider impartially the comparative merits of various materials as weather-resisting agents. Going back to Nature, the metals are of course, never found except in the oxide, the ores. Refining the ore to a metal and exposing this metal to the weather, protecting it temporarily and at undue expense, by a paint, is trying to cheat Nature. You can't do that, not for long anyway. Wood in Nature, exists only as a living organism, sealed in a protective bark. Dead wood rots. Using "killed" wood stripped of its bark, and with a poor attempt at protection in the way of paint, to resist the weather, is trying to defeat Nature,—that doesn't pay.

Stop and think that of all the materials of construction stone alone is *real, natural* and *permanent*. *Concrete* is molded structural stone and weathers no more than the granite cliff. *It is the material enduring.*

From the sanitary side, or on the basis of everyday ordinary *cleanliness*, concrete means much to the home builder. A wall, floor, partitions or flight of stairs, is solid, offering no places of concealment for dirt, rats or vermin and can be really *cleaned*. Timber flooring, timber stud and sheathing wall construction offer every possibly convenience for dirt, disease, vermin and fire.

Concrete is *sincere*, and it is solid. No hiding places are concealed. You can get at and clean every part.

Why build to burn? Why build of burnable material? When every wall, every partition and every floor is simply a series of tinder dry, inflammable flues, is that structure a home—a living place for men, women and children? When a spark from a defective flue will change the shelter of the sleeping household into a raging, death dealing fire trap, can such structures be called homes? Ask *yourself* this question. Build *homes*, not fire-traps.

A word as to cost. Good concrete is always economical and concrete as a home building material, gives the owner the best value for money expended. Concrete invites comparison with other materials at every point, in first cost, maintenance, permanence and real value. For the small low cost cottage, concrete is having a wonderful constantly growing use. Methods have been developed and are constantly being improved to lessen construction cost. Effective organization, steel forms, ingenious mixing and handling plants, pre-cast units, every possible development is being brought to bear by the concrete engineer on the problem of economical construction, and to-day low cost, sanitary, permanent, fireproof concrete homes are within the reach of everybody.

The question may be brought up that much of this could be secured with burnt clay products, and so it might. But, remember that cement is always the binding agent. Remember also that reinforced concrete is at every point the structural factor that makes the use of brick and tile possible. We are in a wonderful era of better construction, of which the dominant and triumphant note is concrete.

*During the Kansas City Cement Show last March, a symposium on cement and concrete was published in the Kansas City "Post." For this symposium the above comment on concrete in its relation to the homebuilder was written by a member of the "Cement Age's" staff, and seems especially appropriate for this House-building Number.—The Editors.

CONCRETE RADIATORS AND MOIST AIR

A RADIATOR for steam or hot water constructed of concrete instead of cast iron or steel piping is a surprise, to say the least.

We find that it costs less, and moreover produces a better, more livable atmosphere. Once more we find an example of wonderful and unexpected development in the uses of concrete.

Concrete radiators are apparently successfully established in Germany, and steps are being taken to introduce them here. In the House-building Number for 1913, or before that issue, we may be able to publish a description of an actual installation of concrete radiators in this country. Refrigerators and radiators, the extremes of household equipment, can both use concrete to good advantage. Truly concrete is the material universal.

CONCRETE HOMES FOR EVERYBODY

CONCRETE for home building is particularly suitable for the low cost house. For the structure which is built with hard earned savings, and where economy must be practiced, but where permanence, beauty and safety from fire are essential, concrete offers more for the money spent than any other material. In a recent issue of the *Saturday Evening Post*, Benjamin A. Howes, in an article entitled "How to Beat the Building Game," by an ingenious analysis, develops the conclusion that it is *not* economical to use concrete in house building, unless the owner intends to spend from $20,000.00 to $25,000.00. Mr. Howes adds: "in view of this undoubted fact, it is regrettable that reputable journals continue to publish—to the hurt and disappointment of countless small homebuilders—such absurd statements as the following: 'The monolithic concrete method lends itself admirably to the small house, and many schemes have been devised for the speedy and economical erection of them. They are but little more expensive than a frame house.'"

As CEMENT AGE must plead guilty to being one of the reputable journals which have incurred Mr. Howe's censure by publishing statements similar to the one just quoted it will not be amiss for us to analyze the article as a whole and see just where we differ with the author.

And let us say at the beginning, that Mr. Howes' achievement in concrete residence work, his masterful interpretation and artistic execution has commanded the warmest admiration of engineers and architects the country over. He has conceived and carried out original, daring and wonderfully satisfying residence structural work, and we believe that his attitude toward concrete homes for the average person is due to the fact that his interests and activities have centered around houses for which the owner could spend "$25,000.00 or more."

It is much like a person with a stiff neck walking in a flower garden. He could only see hollyhocks and the high climbers. The more modest low-blooming plants are there, in all their useful beauty, but he does not see them.

Mr. Howes presents first the "truly tragic spectacle" of the millionaire's timber mansion coated with stucco, which soon began to disintregate in the salt air, which has cost heavily in up-keep, and which is in no way fireproof. From this illustration he turns to one of the houses, which, built by a 'browbeaten contractor" at less than cost, without a thorough knowledge of handling concrete, had inevitably proven a failure, and probably irrevocably prejudiced the mistaken owner against concrete in any form. Here concrete was "its own grim inspector." Poor work will out.

But is either of these examples a concrete house as we know it, and as CEMENT AGE has presented house building development during the past years? Drawing the conclusion from these two *mis*-examples, Mr. Howes says: "If it was suicidal for the millionaire to build in wood, it was no less so, in my opinion, for the clerk to build in concrete—real concrete; but no one has told them so."

Now it remains for Mr. Howes to tell clerks and salaried men in general that it is "suicidal to build in concrete," and that "the coming concrete house for the single builder—who is at the same time a small builder—is not economical at all, but dear in comparison with other constructions."

Mr. Howes in discussing the different types of buildings "which for the several great groups of home seekers are truly economical and satisfactory in the long run," begins "with the rising salesman who can venture to spend six to ten thousand dollars for a country home exclusive of the land." In Mr. Howes' opinion, it is a mistake for such a man to feel that he must build in fireproof construction.

Mr. Howes is to be commended in insisting emphatically on an accurate interpretation of the word "fireproof." A house is not fireproof unless the interior structure, floor, stairs and partitions are of fire resisting constuction. It can be admitted without argument that a *home* should be fireproof. In regard to fireproof houses, Mr. Howes says that the house, entirely of fire-resisting construction, including floors and partitions, "is in the neighborhood of New York not so very much more costly than wood—say ten per cent.; though in the South or far New England it may run to an increase of forty per cent."

A complete fire-resisting structure can be built for ten per cent. more than wood, but note the second paragraph below which says "the pretty wooden house, well kept up, with its large dimensions, will prove as satisfactory and as salable as any other with an expenditure of under ten thousand dollars."

We admit that it might be as *salable*, but is it as *livable?* Mr. Howes suggests that if the ten per cent. extra required for a fire-resisting home structure means giving up other things, extra bathrooms and a portable garage, then live in a fire trap. Have what you want to-day; to-night we may burn up. A good philosophy in its time, but hardly necessary now.

Going further Mr. Howes describes a hunting lodge. Such a structure, with rough unfinished walls, but not so very large, could be built for $10,000. By inference, the reader is led to believe that this is the bottom figure for concrete structures. Such a structure *might* cost $10,000, admittedly. Long hard hauls, no material and no workman at hand might make it cost any sum. But what has this to do *with a fireproof suburban home for the average man?*

"To the person prepared to spend from ten thousand to twenty-five thousand dollars, my counsel will be quite otherwise." The counsel is very good, in a way, for the man who is making his final move, his location in a permanent "residence center." For him Mr. Howes suggests "entire permanence of material, and all but complete fire-protection"; and advises brick with hollow tile interior, or just one story of concrete, with concrete floors. For the man who is spending between ten thousand and twenty-five thousand dollars, for "the half-way house in his career," and for the country house: "the play house pure and simple," the author suggests the well-built timber frame with stucco on metal lath, exterior and interior, and approved fire stops. This will give the owner not the most *value*, but the most *space* for his money, i. e. "the greatest dimension for the given sum." Interesting cases of actual construction along these lines are cited.

So far no mention of the concrete house. The following paragraph explains this, and also contains the sentence quoted earlier:

"Above twenty-five thousand dollars, the problem becomes more complicated as the possibilities of construction open out. The reader may have been surprised that up to this point little has been said of reinforced concrete as a material for houses. That is because, except under unusual conditions, the economies of this material do not appear under an expenditure of twenty thousand dollars. The expert knowledge involved in the proper control of sand and cement—in the choice of proportions, in the mixing, the design of steel reinforcement, the laying of the concrete, and the finish of the surface—make imperative a professional direction of the job. Professional service is too heavy a charge on a small operation, however, which is the reason why it is not at all economical to build the individual modest house of concrete. In view of this undoubted fact, it is regrettable that reputable journals continue to publish—to the hurt and disappointment of countless small homebuilders—such absurd statements as the following: 'The monolithic concrete method lends itself admirably to the small house, and many schemes have been devised for the speedy and economical erection of them. They are but little more expensive than a frame house.'"

And so, in Mr. Howes' opinion, $25,000 is the dividing line. We can't, it seems, hope to build economically in concrete unless we have that much to spend. We who are interested in this development, recognize at once that such an opinion is indicative of a restricted outlook. What concerns us is that such opinions should be scattered broadcast over the land in a representative and popular journal.

We note further that when spending over $25,000 for a residence, the professional service is proportionately reduced; and "what is so widely published of concrete—and unfortunately also believed of stucco 'cement'—that it requires no repairs, grows stronger with the years, can be flushed out with water, is a non-conductor of heat and electricity is all true."

"Good construction in concrete, at the twenty-five thousand to thirty thousand dollar level and over, costs approximately the same as good brick unburnable construction, reckoned at about ten dollars a square foot, including equipment."

As the author seemed to prefer brick in the ten to twenty-five thousand dollar range of houses, the natural inference would be that Mr. Howes does not believe that concrete can compete with brick at any price under twenty-five thousand.

We have endeavored in the foregoing to sum up briefly the article in question. In it a few points stand out strongly against so much that is misleading. The warning against cheap work and against superficial fire-proofing is good. As for floor construction, Mr. Howes recognizes that "there is no economical way of building an unburnable floor without reinforced concrete." The relation of concrete to "damp-proof" walls is stated very clearly.

We regret the publication of such an article, and more so that Mr. Howes should have placed himself on record in such a way. We object strongly to the manner in which he tries to make a scare-face Jack-o-lantern out of the problems of concrete residence construction, a bugaboo that can only be scared away with a $25,000 bill. The entire article, ingeniously, but none the less effectively, and using but part truths, conveys an impression to the lay reader, not only inaccurate but absolutely unjust to concrete development. All the wonderful world-wide and successful development in concrete to produce the best average dwelling at the lowest cost is ignored, and the reading public is misled.

On other pages of this issue are comments on this article from men to whom actual results have demonstrated the relative and absolute value of concrete in home building. These men have devoted their best endeavor toward making possible *concrete homes for everybody*, and as engineer, architect and constructor, they speak authoritatively from actual experience.

Mr. Venable discusses this question from the standpoint of *permanent homes*, and a great truth is brought out when he says that it is not good for the community that any considerable number of people should feel that houses, like clothes, should be outgrown and discarded with great frequency. All the discussions approaching the subject from different viewpoints bring out most clearly the wonderful value of concrete as a home-building material.

PERMANENT HOMES

By WILLIAM MAYO VENABLE
Pittsburg, Pa.

BENJ. A. HOWES' articles in the *Saturday Evening* Post seems to discourage the building of concrete houses to be occupied by the average man. His point of view seems to be that permanency of construction is to be regarded as a luxury rather than as a necessity, and that consequently it may be indulged in only by those whom most people would regard as wealthy—that is, somewhat more than well-to-do.

To the writer, this position seems poorly taken. A house ought not to be regarded by the ordinary man as a shell is regarded by the hermit crab, that is, as a temporary abode to be occupied for a while, outgrown, and left for a more pretentious and commodious abode. The hermit crab, as is well known, has no shell of its own. Very early in its career it takes either an abandoned shell of some other creature of the sea, or lies in wait at the door of some occupied domicile until the owner, afraid to issue from the entrance, perishes of starvation, whereupon the hermit crab drags him forth, devours him, and occupies the abode himself. It is of course, true, that men in the process of getting rich, move from house to house and regard the external appearance and the signs of luxury and comfort of more importance than general utility, durability and protection. A man who is getting rich rapidly is usually taking many chances, and is in the position of being able to utilize ready capital to a far better advantage than the ordinary investor.

The general tone of Mr. Howes' article seems to apply to people in the process of accumulating a fortune, and not to the ordinary man, who, although he may accumulate slowly, is doing so only by rigid economy and by securing the greatest amount of utility from his limited resources. It is undoubtedly true that if a man desires to put up a rather pretentious house in an attractive neighborhood and occupy it for a few years before he moves to Newport, he would be foolish to build of reinforced concrete instead of stucco, if he had to pay fifteen per cent. more for the concrete than for the stucco; but if the object of the man is like the object of most men, not to make a display but to provide a comfortable and permanent home that will not be a constant expense to keep up, and will provide shelter, warmth and protection for many years, he is justified in spending the amount necessary to procure durable and permanent materials and to secure thorough workmanship. Thus, the average man is justified in building of reinforced concrete and in building well. He can, at any time, re-finish the interior of his house in a more expensive style if he so desires. If he builds a substantial structure in the first place, any means that he may have for embellishment and improvement, can be at a later date, employed to advantage, but if he builds a temporary shell of a house and later decides to improve it, he is at a disadvantage, because it certainly is unwise to place extremely expensive fittings in a temporary structure.

It is, however, very desirable that the owner shall not be misled into the building of something which pretends to be concrete and is not. A house, built of good concrete, properly reinforced, secures the many advantages that are inherent in that material. Unfortunately, however, the public in general does not understand, usually, very much about the qualities of concrete work, and the wonderful development of the past few years has brought into the field many men without adequate engineering or construction experience, so that there have been to some extent, unsatisfactory attempts at concrete building. It is absolutely impossible to build a first class, reinforced concrete building of any kind without using first class materials, and, therefore, owners ought to understand that a high grade residence must cost more than a cheap residence because it contains more expensive materials and more of them. Mr. Howes does well in pointing out the fact that a concrete house, like any other really good house, must cost in proportion to its value.

On the other hand, it is not fair to the concrete house to attempt to compare it in cost with the very inferior types of houses that are so frequently constructed of frame, and veneered with stucco or brick. The fact is, that in many parts of the country, extremely cheap houses are put up in which a great proportion of the material supposed to be in structures of their type, is omitted. For instance, in frame houses of the cheaper type, the writer has seen in many localities, weather boards nailed directly to the studding, without any sheathing, and very frequently he has observed the omission of one of the coats of plaster supposed to be applied to the inside. Houses of this kind are put up to sell and the purchaser has no means of knowing that they contain only about two-thirds of the material which they should contain. The same abuse occurs in other lines of building. Therefore, when it is said that a concrete house can be built for ten or fifteen per cent. more than a first class

(*Concluded on page 222.*)

FIG. 1—AN INTERESTING BUNGALOW DESIGN AT WASHINGTON.

AN ALL-CONCRETE FIREPROOF BUNGALOW AT WASHINGTON, D. C.

This bungalow has concrete walls, concrete partitions, concrete floors, concrete ceiling and asbestos shingle roof. It is heated by a hot water boiler which is placed in the kitchen — with a coal storage-bin adjoining the heater. For the concrete floor a layer of one foot clean cinders was placed directly on the graded earth; cement flooring being laid directly on this. This building has no plaster on the inside, as the inside and outside surfaces each have a cement coating. The steel forms in which this building was poured leave a smooth finish, only a slight ridge, formed by the imprint of the moulds. This pattern has been treated as decoration inside and out with quite satisfactory results. While the solid concrete walls have proved dry and no difficulty has been encountered in heating the house during the past cold winter, the architect would not advocate this type of construction in more Northern States where the dwellings are to be occupied the year around; as the walls being of solid stone conduct cold too readily.

This type of construction would be especially suited for summer cottages. Ten per cent. of hydrated lime was used throughout the mix for damp-proofing. As the steel forms are practically water tight, a slush mix was used, giving an extremely smooth wall. Where similar houses are being used

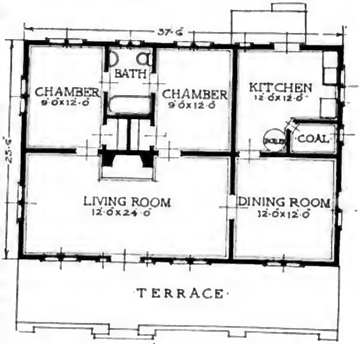


FIG. 2—FLOOR PLAN OF CONCRETE BUNGALOW.

in colder climates, small wooden nailing blocks are dropped in the concrete to which 1 x 2 furring strips are attached. Composition wall boards are attached to these strips with wood strips covering joints. This method of finishing the interior, gives good results; the wall boards are of an interesting brown color, and the plastering is entirely eliminated and fast work is possible.

This bungalow, built for V. M. Hillyer, at Woodley Lane and Idaho ave., Washington, D. C., is valued at approximately $3000. Milton Dana Morrill of New York is the architect.

(Continued from page 220.)

frame house, it should be remembered that inferior frame houses or brick houses are built for less figures and are very frequently offered to people who have not the knowledge necessary to detect the inferiority.

The heavy item of expense in the poured concrete house is the cost of the form work. If the form work could be materially reduced, the cost of a house can be brought to a point where it is little, if any, in excess of the cost of a good house of perishable materials. To reduce the cost of forms requires the standardization of the forms and the construction of forms in a manner which will permit them to be reused econmically a very great number of times. This is the key to the problem of constructing concrete houses economically to compete with wooden houses. In order to standardize the form work to the greatest extent possible consistent with a pleasing appearance, it is necessary to limit somewhat the intricacy of the design of the surface of the walls. This limitation, however, does not have the effect of rendering it impossible to procure good designs without great complexity of surface.

Those who are engaged in this work for better homes, are not engaged in misleading the public into constructing concrete houses under circumstances where the owners would be better off if they constructed frame houses, but they are actually engaged in introducing construction of a much more permanent character than has in the past been the practice, without incurring an unwarranted additional cost. The number of people who will build permanent small houses is increasing, and undoubtedly will continue to increase. The proportionate number of frame houses will correspondingly decrease. It is a healthy sign in the community that this is so. It is not good for any considerable number of people to feel that houses, like clothes, should be outgrown and discarded with great frequency, or that the community can afford to waste its energies on rebuilding the residences of the bulk of its population once or twice in a generation. Rather than discourage the construction of concrete houses of moderate cost, it should be the object of architects and builders to encourage the construction of such houses, but to see to it that wherever concrete houses are constructed, they shall be what they pretend to be and shall not be foisted upon the public in the same way that inferior structures of other types are being exploited.

AS TO CONCRETE HOUSES

By ALLEN HAZEN*
Consulting Engineer, New York City

Mr. Howes is largely right when he states that the amount of skilled supervision required for the erection of a concrete house is too heavy a charge upon a small structure. This is perhaps the most serious obstacle to more general use of concrete in small houses at the present time.

To build a good wooden house probably requires as much technical skill, and skill of as high an order, as is required for the construction of a concrete house, but the art of building concrete houses is less developed today than was the art of building wooden houses a hundred years ago.

All the various workmen who have to do with the construction of a wooden house have learned, by long experience with such structures, what can be done and what cannot be done. Many of them have served, at one time or another, under skilled builders who have taught them proper methods, and this information has been passed from man to man, and its existence makes it possible to build a tolerably good wooden house with a minimum of skill and attention on the part of owners and supervisors.

With concrete, on the other hand, the business is comparatively new. Many, or most of the workmen that would be employed have not had corresponding training in the work they have to do, and every stage, from the design to the finished work, must be intelligently followed by one sufficiently well grounded in the business to know what he wants, and to be incapable of being imposed upon by workmen who are reluctant not to do things in the way that they have learned to do them in other kinds of structures.

If it were only a question of getting the largest house for the money, as seems to be assumed by Mr. Howes as the object of most builders, there would be few concrete houses built under present conditions. But a large house is not the only object to be attained. Beyond a certain moderate minimum, it may be questioned how far increasing the size of a house adds to the comfort and happiness of those who occupy it; and there are some people who are glad to have, even in a small house, the excellent qualities that can be obtained in a well-designed and well-executed concrete house.

In comparing the relative costs of concrete and wooden houses, the mistake should not be

(Concluded on page 224.)

*Hazen and Whipple, Consulting Engineers, New York.

FIG. 1—A CONCRETE BUNGALOW NEAR WASHINGTON.

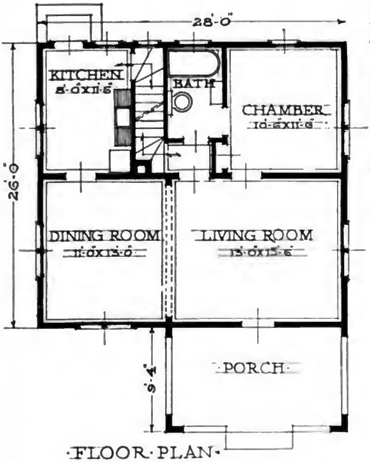


FIG. 2—FLOOR PLAN OF CONCRETE BUNGALOW.

A Low Cost Concrete Bungalow

THE residence of D. M. Kidwell at Virginia Highlands, Virginia, is shown in the accompanying illustration. This house contains four rooms and a bath; the attic space is large, and there is a cellar under half of the house.

The walls are of poured concrete as also are the main partitions. The floors and roof are frame. Milton Dana Morrill is the architect.

The total cost, including hot water heat and plumbing, wiring and electric fixtures was $1,459.44.

(Continued from page 222.)

made of comparing the best concrete houses with the cheaper wooden houses that are most frequently built. If the wooden house is as well built throughout as some concrete houses have been, the cost will be increased to much larger figures than those ordinarily quoted, and may be as great as the cost of the concrete house.

At the present time the cost of construction in concrete is often greater than it otherwise would be, because the design is made for other building materials, and it is then adapted to concrete without change, or with but inadequate change. To build a concrete house economically, it must be designed for concrete construction. To build a reproduction of a well-designed wooden house in concrete is unnecessarily expensive. When the art of concrete design is further advanced, it will be possible to build houses of attractive design that are also capable of economical construction. Some progress has already been made and the writer looks for a marked development in the next ten years.

NOTE: It will be remembered that in CEMENT AGE for May, 1911, were described the three reinforced concrete houses built at Dobb's Ferry for Allen Hazen, Weston E. Fuller and L. N. Babbit, of the firm of Hazen and Whipple, consulting engineers, New York. These houses were of poured concrete walls and floors, timber frame and tile covered roofs. The over-all cost of the three houses was approximately $38,000, for a total plan area of about 5,086 sq. ft. This area includes one-third of the garage and porch area.

This was concrete construction of the best kind, carried out for engineers by engineers. The cost was approximately $7.50 per sq. ft. In the letter enclosing the above statement, Mr. Hazen says: "'We are very much pleased with ours (our concrete houses) in every way."

This is an instance, and only one of many, where "what is so widely published of concrete, * * * * that it requires no repairs, grows stronger with years, can be flushed out with water, is a non-conductor of heat and electricity, is true." And instead of this being true at over $25,000, as Mr. Howes seems to believe, it is possible at a cost of less than one-half Mr. Howes' minimum. Smaller houses, under similar conditions of being built in groups, can be and are being built at a low cost, and, to quote Mr. Hazen, the owners "are glad to have, even in a small house, the excellent qualities that can be obtained in a well-designed and well-executed concrete house."—THE EDITORS.

THE LOW COST CONCRETE HOUSE

By MILTON DANA MORRILL
New York

EUROPEAN cities afford us an excellent example of permanency in the way of home building; the flimsy frame structure is there unknown either as a home for the wage-earner, or for housing the family of large income. It is not economic construction when wear and tear, fire risk and sanitation are to be considered. One needs only to review the annual fire loss in lives and property to prove our short sightedness in erecting frame buildings. We are now, however, awakening, and action is being taken by the municipal authorities of our most progressive cities, to limit the construction of frame houses.

Sanitation is also a matter which should enter into general construction. The reports of societies on the prevention of tuberculosis show that contagious disease once developed in a house of ordinary construction, makes further habitation therein of considerable danger. Today, fortunately, the public are demanding better sanitation and better construction and our thinking men are studying this question of proper housing.

Reinforced concrete is today recognized as the most substantial and best material in which to build. It is, therefore, simply a matter of reduction of cost and this material will supplant present methods in home building, as it is doing in engineering works and heavy construction.

The increasing price of lumber, together with the high cost of skilled labor, necessary in the making of wood forms, has heretofore made the high cost of monolithic concrete home. Sand, gravel and cement at most of points in this country are obtainable at a moderate cost, and the question therefore becomes one of erecting forms, and placing materials at a lower cost. The writer has felt that the solution of this problem lies largely in the development of a satisfactory system of steel forms, which should be so flexible as to permit the construction of various types and dimensions of buildings, and which should be capable of being used over and over again, and with which unskilled labor for the most part, could be employed. It is largely the same question that has come up in the manufacture of other things about us, and means that house building must be reduced to a mechanical process. Much has been done, and many houses have been built with steel forms, demonstrating the possibilities of building low cost fireproof and sanitary houses in concrete. If we are, however, to make progress in this work, a public educational campaign must be carried on; and improvements in designs and construction must be demanded by the home builder or the tenant. If the owner finds that the public demand fireproof buildings, necessity will force him to improve his construction. We are extremely slow to learn even by bitter experience, as has been shown in the re-construction of fire swept towns, where often the new buildings have afforded less fire protection than those wiped out?

FIG. 1—A CONCRETE BUNGALOW OF GOOD DESIGN.

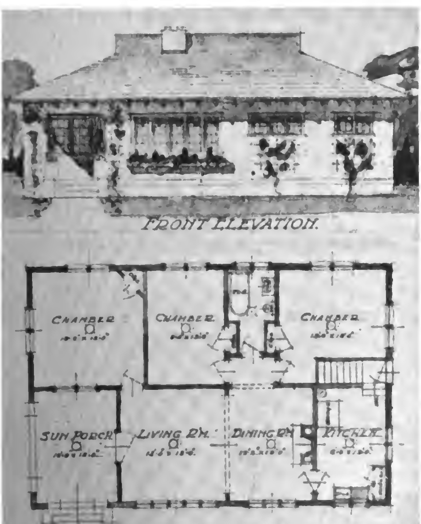


FIG. 2—ELEVATION AND PLAN OF SMALL CONCRETE BUNGALOW.

A SMALL CONCRETE HOME

THIS is a bungalow with poured concrete walls, and contains six rooms and a bath. The sun porch is arranged to be enclosed with screen in summer or with sash in winter, affording the opportunity for living in the open air. The dining-room and living-room open together. This residence was sold for $2,500, which includes the builder's profit. Hot water heat, standard bathroom, and natural wood finish, and Southern pine floors were specified. The bungalow was recently completed at Virginia Highlands, a suburb of Washington.

The average house designed for frame or brick is not easy or natural to build in concrete. We must adopt forms and details suited to the material in hand. The artistic possibilities in concrete are without limit, if developed in a natural way; the lintel construction and design is the natural expression of reinforced concrete.

We are using arches and vaulted ceilings, but these are traditional largely as they are not natural structural forms for such material. We must study and think in concrete if we are to develop the best in architecture and construction, but from the results already obtained, it is evident that concrete can be economically adopted for the inexpensive house, and it remains for us to develop ways and means by which the house for every man may be built in a fireproof, timeproof and sanitary construction.

LOW COST CONCRETE HOUSES

By A. A. PAULLY*

In regard to Mr. Howes' article on the cost of concrete houses I will say to the readers of CEMENT AGE that there have been built in Youngstown, some three or four hundred houses of concrete tile, and it has been used on as many other jobs for partitions, cellar walls, etc. The market increased 100 per cent. the first year, stayed about stationary the second year, the third year increased about 25 per cent., and this year from present inquiry and orders on file it will increase another 100 per cent. We have not done a great deal in what you would term, all fireproof residence construction. In a great many jobs, we fireproof the first floor, which usually adds about $100 to the cost of a $1,500 to $3,000 house. If we were to advocate fireproofing of the balance of the house it would run our costs up on cheap house construction so the people would not now stand for it. We have been content with educating them to get their outer walls fireproofed thinking eventually we might succeed in getting the balance of the house, when lumber becomes high.

I think that Mr. Howes, if he were to investigate conditions as they apply to concrete tile construction, would agree with me that the outer walls can be built anywhere east of the Mississippi River at about the same cost per sq. ft. of wall as first-class framework. This includes a good coat of stucco on the tile, and paints in the frame house.

As soon as we commence to advocate fireproof floors in cheap houses, especially houses that people usually borrow the money to build, they will say that the difference in the cost is just as good to them as to the fellow that does the fireproofing. In fact, it is hard to make a man believe that a concrete floor will cost any more than a wood floor especially when you tell them the outer wall is the same.

I do not hesitate in saying, and the success I have had at home will bear me out, that I can build the outer walls as cheap as wood, with but one exception. In wood construction, they do not require in our location any footings whatever under the cellar, or house foundation. With concrete construction, this is necessary, and in an ordinary $1,200 four room, working man's house, this can be built in wood, on account of eliminating that in our city, for $1,150. We lose a great many jobs just because we cannot reduce our price another $50.

*Youngstown, O.

CONCRETE HOMES FOR EVERYBODY

By ROLF R. NEWMAN*

As an engineer and constructor specializing in concrete residence construction, I have been more surprised, perhaps, than many other readers of Mr. Howes' statements, because my experience has proven many of the things which he labels as economical impossibilities to be practically possible. Concrete can be used to form the major portion of houses costing as low as $2,500, and ranging from this figure up to $3,000 and above. I can refer to two very satisfied clients, one Jesse T. Speare, of Atlantic, Mass., for whom I erected such a solid concrete house costing $3,000 (a view of this house appeared in CEMENT AGE of May, 1911), and R. J. Nelson, of Riverside, California, for whom I am just finishing a concrete block residence costing $2,500. I have built isolated concrete gate houses costing as low as $300, and I have had engineering charge of a group of concrete factory buildings costing $1,000,000, and with concrete floors and partitions my idea of the low limit to set as the cost of a 7-room all-concrete house is $4,000. Between this figure and $20,000, as set by Mr. Howes, are a world of possibilities soon to appear as practical realities.

*Riverside, Cal.

CONCRETE QUALITIES IN RESIDENCE CONSTRUCTION

By A. MORGAN SMITH
Mt. Lebanon, Pa.

WHEN I talk concrete residence to a prospective builder, I bring out the efficient qualities; that it is indestructible, that it is fireproof, warm in winter, and cool in summer. All this I clearly demonstrate by a visit to a reinforced concrete residence.

Monolithic construction means no joints or cracks for water or air. A concrete roof gives space for out door purposes. A skylight affords light and ventilation, and makes rooms with all interior walls possible. There are no springy floors, nor hollow partitions for vermin to establish thoroughfares.

Up-keep cost is absent. Exterior painting is limited to window frames. There are no porches, tin work or roofs to rot.

Fire insurance is unnecessary, and the mind is relieved of the fear of fire. The man with $5,000 or $25,000 can have all these advantages by building of concrete, and *at a cost of 15 to 20 per cent. less than any other fireproof construction.**

To duplicate a residence that I at present am building, costing about $9,000, could not be done with brick or terra cotta for less than $11,000. But the house of the same size could be built in the conventional fire-trap, shoddy manner for about $8,000. About Pittsburgh, this will hold true for any house from $5,000 to $25,000.

Is it fair then to expect the qualities and merits of a reinforced concrete residence to be had for the same price as one can build the flimsy, destructible fire-trap building?

The man with $5,000 considers first cost, and an additional 10 per cent. will usually stand in the way. In ten years, however, he would have had it all back in up-keep costs and fire insurance. I find that men of a technical training most readily take to the reinforced concrete construction for residences. I believe the concrete residence will soon be recognized as the standard of quality in building construction, and to maintain this distinction, cheapness of first cost is not the best slogan. I believe, quality considered, the cost of concrete is lower than any other manner of construction.

NOTE: A. Morgan Smith is an architect who has executed some original work in reinforced concrete. He has recently completed a residence of monolithic reinforced concrete, not only for the foundations, walls, beams, partitions and floor slabs, but also for many details such as mantels laundry accessories, shower receptor, baseboard and trim, flower boxes and water tanks. Surmounting the walls is a parapet, the upper rail of which is trough shaped for holding plants and vines. The owner calls it a "Florapet." The roof is of concrete, reinforced against expansion, and has a slope of ¼ inch to the foot, draining through two central leaders to the basement. The exterior walls are finished in two colors, the body being gray and the trim white, the aggregate being white sand with white cement. Concrete has been used extensively inside as well, though the floors are of oak, laid on 2 in. by 4 in. sleepers. There is no main stairway in the house, instead a ramp or incline has been built.

Mr. Smith writes in a former letter that the residence was *bone* dry when completed, even with an exceptionally wet season.

In regard to heating we further quote: "An extra large hot air heating plant in keeping with the size of the house was installed. During this last cold weather when the temperature was 16 degrees below zero the entire building was easily heated, and could have been heated with a considerably smaller furnace. The walls of one room (children's playroom) was not furred for an air space; the walls show no signs of sweating or dampness. The plaster was applied direct to the cinder concrete wall. The concrete roof has had a thorough test and is perfect.

"The 'ramp' has proven, to the owner's satisfaction, one of the sanest improvements ever put into a residence. It is safe, easy to ascend and descend, and essentially practical. The entire inclined plane is formed of concrete; the tread surface is covered with rubber tile. The concrete sanitary features have all proven as expected—satisfactory in every way. The sky-lights, so very adaptable to flat concrete roof construction, are especially effective, particularly with the connecting bathroom having no outside wall for window space. The light is amply intense, the skylight being 24 in. by 30 in. During this severe winter weather the concrete fireplace in the living room has afforded not only comfort, but has been a source of delight. Only those who have enjoyed the luxury of a large old fashioned fire-place with its huge logs all aglow can fully appreciate what this fire-place has been to its owner and his friends who have gathered around it during the winter evenings, and watched the smoke and fire from the big five foot log.

"The concrete 'Florapets' was a mass of blooming flowers until the frosts came."

The world over, concrete is a material which craftsmen use in working toward the ideal in home building. We find in this Mt. Lebanon home several original developments that will make for better living in all homes.—EDITORS.

*The italics are ours.—Editors.

Precast Concrete Units in Residence Construction

By ROSS F. TUCKER
New York

I HAVE read Mr. Howes' article with much interest. Mr. Howes is evidently unfamiliar with methods of handling concrete by which dwellings can be built which are fireproof, dampproof, strong, durable and artistically satisfactory, at a price so close to the cost of wooden frame, and cheap wooden frame at that, that the difference is negligible. Quite the reverse of being a rich man's material, concrete is essentially a poor man's material, inasmuch as it is adaptable to the small inexpensive dwelling, even the so-called workingman's house.

I will attempt to describe, as briefly as possible, one method* by which concrete may be applied to dwelling house construction with great economy and with positive results as to strength, durability, dampproofness, fireproofness and artistic appearance. While admitting that some of the work done with concrete is most unsatisfactory, this is no fault of the material itself, but of the ignorance or dishonesty involved in the use of it. Stucco makes an excellent finish when proper materials and workmanship are used, and it may be applied to any surface, brick, tile, concrete or metal lath, without any danger of poor results, if done by men who know how.

There are now being manufactured in many parts of the United States wet process hollow concrete tile, which are dense, strong and cheap. These tiles are easily laid and form double cellular walls that are dampproof, and are made in a variety of shapes and sizes. For foundations, large tile are made with cells running vertically and these are laid one on the other and filled with concrete, thus doing away with wooden forms and carpenter's labor and procuring a wall 8 in., 10 in., 12 in. or 16 in. thick that is probably superior to any solid wall.

For upper walls 8 in. or 10 in. tile are used, the cells running horizontally in the body of the wall, thus securing a double cell insulation that is proof against dampness. The only necessary precaution is that the joints between the tile be carefully pointed. At the corners and for window jambs, tile with vertical cells are used, and these are filled with concrete, as are also the tile directly under the bearing of the floor beams. Rebated tile for window frames are readily formed to meet any required dimensions and all other structural requirements for pipechases and recesses, bay windows, etc., are easily provided for.

Such walls can be laid for 18c. per sq. ft. net area of the wall, and when stuccoed with two coat work do not cost any more than wooden frame walls. Plastering can be applied directly to the inside of the wall thus eliminating the cost of furring and lathing. I am quite aware that there is a great deal of skepticism in respect to this latter detail and I had serious doubts about it myself until I proved conclusively to the contrary by successful work on many structures.

For floor work an inexpensive fireproof construction consists of factory-made reinforced concrete floor joists which are set in place on the building in the same manner as wooden joists. The concrete beams are of standard design and while having greater carrying capacity than wooden beams are much stiffer and less subject to vibration. Reinforced slabs are bedded on the lower flanges forming a ceiling ready for plastering, and on top the joists are provided with a nailing strip.

Such a floor is a little more expensive than a wooden floor but the difference is of small consequence considering the cost of the house as a whole and the great security and permanency involved in such construction.

It is well known that the majority of dwelling house fires originate in the basement, and if concrete tile walls and reinforced concrete floor joists are used even for the first floor alone, the greater part of the fire hazard is eliminated and for stability, durability, warmth and general efficiency over wood, there is absolutely no room for comparison. Such houses can be built almost as cheaply as wood, so cheaply in fact, that there is no excuse for building in wood at all.

In all the years that I have been engaged in the development of concrete construction, I have had a desire to produce a method of building in that splendid material by which we might begin to do away with the wretched wooden construction which is an imposition on the public and a menace to our suburban communities. The fire losses outside of the cities are almost exactly as large as in the cities and this enormous economic waste amounting to $2—for every man, woman and child in the land, must be reduced. It is one of the causes of the high cost of living and any advance in the art of building that will eliminate a portion of this loss is of the greatest importance to the public. Concrete is the material that will do it and the methods above described will in due time become so perfected that the small difference between wooden and masonry construction that now exists will soon disappear, a consummation much to be desired.

*A residence built by this method is described on page 238 of this issue.

AN ALL-CONCRETE RESIDENCE WITH UNUSUAL FEATURES

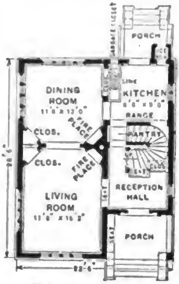
This residence is of monolithic reinforced concrete throughout; the only wood being the sash and doors. The walls, floors, roof and partitions are of concrete. Upon this design the architect, Milton Dana Morrill, was awarded the first gold medal by the International Congress on the prevention of tuberculosis, as a design for a home which would be as proof against disease as is possible to build, and permit living in the open air as far as is possible in our climate. The maximum of fresh air and sun-light are afforded. With the large casement windows open the whole house becomes an open air living porch. The roof garden is used by the whole family for sleeping out-of-doors; the central sun room serving as the sewing-room. An attractive outlook over the city of Washington is here a feature. This house can be literally flushed out with a hose; the interior walls are not plastered; the concrete work being floated to a smooth finish as soon as the steel forms were removed. The same forms were used as the centering for the floors and roof. The concrete work is monolithic, reinforced generally with ⅜ in. sq. rods, 9 in. on centers in both directions.

A simple system of wall insulation has been successfully employed on this building. Rough boards of box lumber, ½ in. thick were placed and temporarily stayed in the middle of the forms by wood yokes or combs. This rough boarding was thoroughly water soaked before placing. The concrete is poured on both sides of this insulating board; bond irons connecting the inner and outer walls 1 ft. on centers. The combs or yokes are

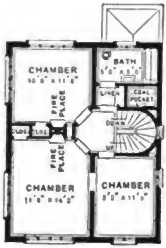
FIG. 2—CONCRETE STAIRWAY AND BALUSTRADE. INTERIOR OF THE ALL-CONCRETE HOUSE.

FIG. 7—THE ZUCCA RESIDENCE DURING CONSTRUCTION.
This is taken diagonally opposite the view shown in the frontispiece.

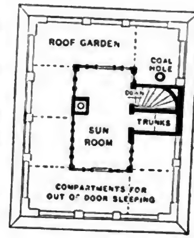
pulled out after the concrete is poured, leaving this insulating board in the center of the walls. It is possible in time that this central board will be attacked by dry rot, but as it serves only for insulation, this would hardly be detrimental. The building is heated by hot water; low radiators being placed under the windows, forming window seats when heat is not required. All corners at floors, angles and ceilings are coved so that cleaning and sweeping is easy. The bath tub is solidly built in, extending to the floor so that no lodging place for dirt or dust is here left.



First Floor Plan



Second Floor Plan



Roof Garden

For the windows and doors, collapsible frames were dropped into the forms, forming inside and outside rabbets. Hinge blocks and blocks for se-

FIG. 4—THE LIVING ROOM IN THE CHANTLAND HOME AT WASHINGTON.

curing hardware were attached to these collapsible frames, these blocks being dove-tailed, bevelled and bedded in the concrete. Metal drips are bedded in the concrete over exterior windows and doors; casement sash swung out, making a water tight construction. Between the sash *T* irons bedded in top and bottom in concrete form mullions and divide the casement sash. The stairs and railings are of concrete. Concrete window-boxes serve, when filled with flowers, as an attractive decoration.

The detailed costs on this house are as follows:

Excavation and grading	$75.80
Concrete and cement work	1,074.21
Special window and door forms, sash, insulating board and carpentry labor	495.60
Hot water heat	200.00
Plumbing, including solid porcelain fixtures	317.20
Painting and cement coating, materials and labor	178.52
Hardware	43.82
Slag roofing	24.00
Electric wiring and fixtures	60.00
Reinforcing steel T Bars for windows	80.00
Total	$2,549.15

For dampproofing, oil was added to the concrete, using oil to the extent of 5 per cent. of the volume of the cement. This heavy crude oil was used throughout. The oil was mixed in the concrete just before placing after the sand, gravel, cement and water had been thoroughly mixed. The alkali in the cement emulsifying this oil so that it disappears in the mixture. This had made the walls absolutely damp-proof without weakening the mixture to an appreciable extent.

The owner, for whom the house was built and who is now occupying it, is Col. Wm. Chantland, of Washington.

When the award on this house was made by The International Congress for the Prevention of Tuberculosis, this house, then, in plan and model, were described in both Cement Age and Concrete Engineering, in May and April, respectively, 1909. It is a pleasure at this time to record the successful accomplishment of plans that mean much for better housing.—The Editors.

REPAIRING CONCRETE SURFACES

At the recent annual meeting of the American Railway Engineering Association, in Chicago, the Committee on Masonry reported as follows on the subject of repairing surfaces:

In all cases the surface to be repaired must first be thoroughly cleaned of all loose material, laitance and dust and the clean, rough, sound concrete exposed to receive the patch. Probably the best method of cleaning is by means of a steam jet.

After cleaning, th surface to be repaired must be thoroughly saturated with water, not simply moistened, but so thoroughly drenched that the old concrete will not absorb water from the new mortar or concrete used in patching. If possible, the surface should be kept covered with water for several hours.

If the repair of patch is to be made on a vertical or sloping surface and is not to be more than 1½ ins. thick, the surface of the old concrete, while it is still wet, should be spattered or splashed with a cement grout, following this immediately with a fairly stiff plaster coat of mortar made of the same proportions of cement and sand as was used in the original concrete, but never richer than 1 cement to 2½ sand. This plaster coat should not be thicker than ½ in. and each coat should be forced into the surface, but not dragged with a trowel. The surface of each coat, except the final coat, should be "scratched" to give a bond for the next coat. This plastering should preferably begin at the top and progress downward, and only enough time be allowed to permit each coat to receive its initial set before the next coat is applied. The final coat should be finished with a wooden float and only enough water used to properly finish the surface. This patch should be kept damp and protected from sun or frost till fully set up.

If the repair or patch or "finish coat" is to be made on a horizontal or nearly horizontal surface, the surface of the old concrete should be slushed and broomed with a thin cement grout, following this immediately with a wet mortar made of 1 part cement and 2½ parts sand or granite screenings and of the full thickness required (not less than ½ in. thick, however). When this mortar begins to take its initial set, it should be floated or troweled to such a finish as may be desired.

If the repair or patch is to be made on a vertical or sloping face and is to be more than 1½ ins. thick, it will be advisable to imbed dowels into the old concrete, as deeply as the thickness of the proposed patch, and spaced sufficiently close together to firmly anchor the patch to the old concrete. The dowels must be wedged into the old concrete and it will be advisable to fasten wires, metal fabric or bars to the dowels, in the case of extensive patching, as an additional safeguard. The patching may then be done with mortar without forms, or with wet concrete supported by forms, depending upon the thickness and the extent of the patch.

If the repair or patch is to be made on a horizontal or nearly horizontal face and of considerable thickness, dowels may be used, or the concrete may simply be reinforced by fabric or bars without using dowels—treating the patch as a block of masonry.

Care must be taken not to have thin edges on patches. To avoid this, it may be necessary to cut out sound concrete around a place to be patched, so as to give deep edges to the patch. If possible, the edges should be undercut.

Concrete School Buildings in the Philippines

While this country is still putting up school buildings of combustible material, away off in the Philippines they are building them of reinforced concrete. More than 200 buildings of this type are under way. They are constructed on standard plans, prepared for provincial, central and barrio schools. A unit system of building is adopted by which additional rooms may be added to the building as they may be required.

CONCRETE IN RESIDENCE DEVELOPMENT

INTERESTING uses of concrete in farm work and about the country house are seen on every hand in a farm residence at Oakland, N. J. More than fifteen years ago, Edward D. Page built a Greek Temple over the reservoir on a hill-top near the house. The barns, even to the roof, are interesting examples of monolithic work. It is, however, chiefly the addition to the house that is of present interest. This building houses a library on the first floor, above which is a picture gallery, in which is to be installed an Aeolian organ. A small chapel near the stair-case is also found on this floor. From the valuable and destructible character of its contents it was of first importance that this building be fireproof and in accomplishing this end concrete was liberally used. The floors and part of the roof were of tile and beam construction covered with a concrete slab. The main walls were built of a kind of bastard granite, found outcropping in boulders on the farm. Forms were built for the inner face of the wall, the split granite laid up to form their outer face and grouted into place with concrete. The resulting wall is about half concrete and half stone. It proved to be a great saving in expense over a full granite wall and produced exactly the same exterior effect.

The stair hall is designed along classic lines with a full order, which is being executed in cast concrete. The stairs are built of concrete with marble treads and wrought iron balustrade. The chapel has a vaulted ceiling in concrete following closely the structural outline of the roof and walls.

THE ENTRANCE: There is here illustrated the entrance to the addition. Its color is that of Caen stone. It is being executed by the Hall Concrete Products Company of Philadelphia, and set by Gideon De Nutt, the general contractor for the work, to whose ingenuity and the owners', are due most of the interesting constructive features of the building. The casting, in one sense, is a simple process, which might be described as the making of a composite stone of the color and texture of Indiana limestone. But it requires expert supervision and skilled workmen to insure success.

The first proceeding is to enlarge to full size the architect's drawing reproduced herewith. From this enlarged drawing templates in zinc are made preliminary to running the moldings in plaster. These metal units when all set together, form a counterpart of the doorway, which is then reproduced in plaster, but without the ornamental features. On this plaster model the sculptor proceeds to place all the ornaments, which are modeled in clay. This done, there is a complete model of the doorway. There is then formed around this model a shell of plaster, but with sufficient space intervening for a gelatine mold. This hollow space is obtained by covering the model with a thin layer of clay before the outer shell of plaster is cast. The latter is then cast and removed when hard, exposing the clay, which is also removed. After taking out the clay the model and outer shell are again set together and gelatine is poured into the space formerly occupied by the clay. When this hardens the outer shell or mantle is again removed, leaving the model entirely encased in a coating of gelatine. This gelatine covering is cut in places that correspond to the joints of the outer shell, the entire doorway representing perhaps 30 or 40 of these pieces. The several parts of the gelatine mold are then put back into their respective positions in the outer shell. The gelatine surface is treated with a liquid wash that prevents it

FIG. 1—ARCHITECT'S PERSPECTIVE SHOWING ADDITION TO A COUNTRY HOUSE.

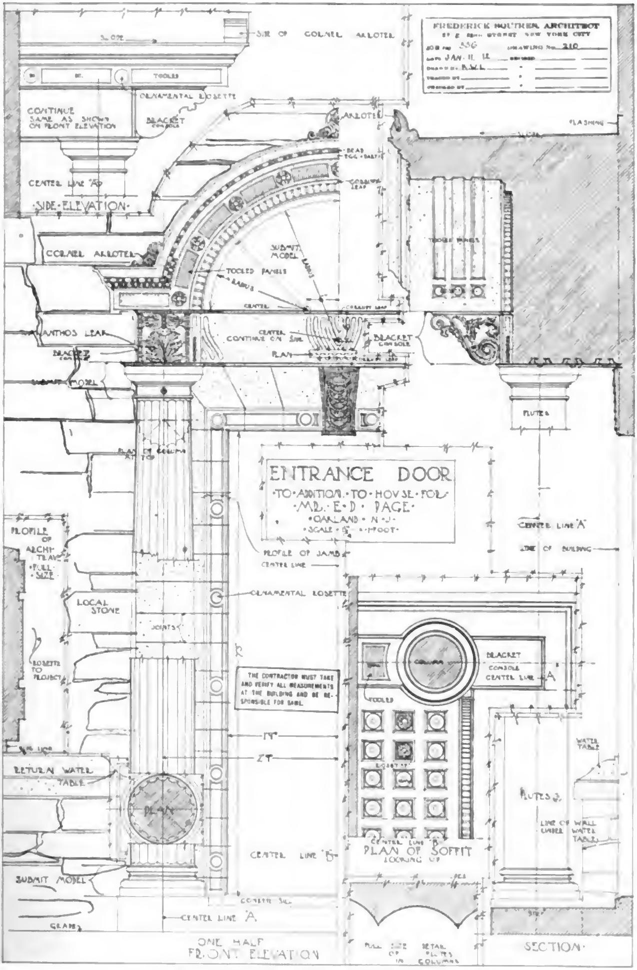


FIG. 2—DETAIL OF FRONT ENTRANCE.
This entire work is pre-cast in concrete.

from adhering to the concrete. The molds are then ready for the final pouring of the concrete, which produces the doorway in time-proof and indestructible stone.

If the object to be cast is hollow a core is placed in the mold. The concrete in this case was 1 part "Medusa White" cement and 2 parts crushed marble or silica sand, giving the color required A very wet mix is made and allowed to remain in the mold from 18 to 36 hours, depending upon atmospheric conditions. This mixture gives a dense and impervious concrete without the use of waterproofing. Reinforcement is used in the columns and arch. As stated, this doorway will be cast in several parts, which will be assembled at the house as though so many units of cut stone.

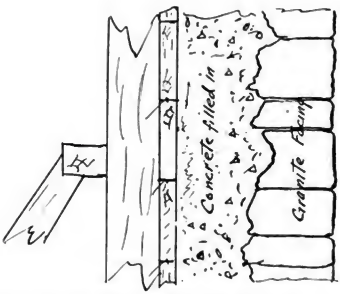


FIG. 3—DETAIL SECTION SHOWING GRANITE FACING AND CONCRETE BACKING.

By means of the gelatine mold it is possible to reproduce the most delicate and elaborate patterns, as the gelatine coating is elastic and may be withdrawn from undercut designs. There is practically no limit to the color schemes that may be devised.

The entrance design follows in general the later Italian Rennaissance. The arch is 3-centered, and there has been at no point any compromise to concrete, as the work was designed as perfectly, architecturally, as though it were to be carried out in the finest hand-carved work.

Seeing on the same farm two concrete structures built fifteen years apart, one is interested in noting what if any advance has been made in that time. The most obvious difference is in the use of steel reinforcing. The Greek temple was built without it. Not a foot of the new structure but uses it. The older work is in the mouse colors, the new work, where exposed, is the color of

FIG. 4—EXTERIOR OF COMPOSITE GRANITE AND CONCRETE.

Caen stone. Light colored cement has done much for artistic advance in concrete. The Greek temple shows no ill effects from fifteen years exposure on a hill-top. By the time the Library and the Temple have begun to fail this little difference in age will have been forgotten.

Frederick Squires, of New York, is the architect, who has designed the entire work, and developed some original and beautiful details.

CONCRETE HOMES IN CHICAGO

The E. A. Cummings Co., of 40 North Dearborn street, Chicago, have lately built a large group of attractive bungalows and reinforced concrete houses in their cement suburb development at High Lake, near Chicago. They report that their cost has been less than for similar buildings in frame. Their cost of handling steel forms has been 2/3 of one cent per sq. ft., including both faces of walls. Their total cost for 6 in. reinforced walls has been but 8 cents per sq. ft., where sand and gravel were easily and economically obtained. They have gained remarkable speed in house construction, as they are completing the entire walls of bungalows, including basement, first story and gables in from four to six days. The work here has been under the direct charge of W. L. Twining, superintendent, to whom much credit is due for the remarkable and attractive group of model houses, which have proven during the past cold winter, the warmth and comfort, which the concrete house, properly constructed, affords. The houses have found ready sale, as the public recognized in them, the best and most substantial construction known today.

PRE-CAST UNITS IN ECONOMIC CONSTRUCTION

IN the December, 1910 issue of CEMENT AGE, Grosvenor Atterbury, of New York, presented an interesting discussion of economic design for residence construction. The problem was carefully analysed, and study and experiment conducted through a long period indicated that the theoretic solution of the problem, at least, must consist in the employment of a more or less standardized, shop-made, and completely finished building section or unit, of the maximum economic size, as determined equally by the type of structure into which it enters, and by the latest mechanical devices available for its manufacture, transportation, handling and erection.

This position was arrived at after a carefully considered process of elimination. To start with, there are three general methods of construction as outlined in Mr. Atterbury's program:*

First. The structure may be cast by the introduction of concrete into molds "in situ."

Second. The structure may be built up of large standardized units cast in a factory with the aid of machinery at or near the site of the work to be executed. Such sections could be practically completed with respect to all such items as finish of surface, ducts and chases, leaving the very minimum of labor to be performed in the building over and above the assembling of the sections. This system promises certain great advantages, not only in the manufacture of the sections which can be continuous without regard to weather conditions, but also that the machinery necessary for erection might be comparatively simple and easy or transportation, so that a greater part of the economy due to standard manufacture might accrue even in the case of single buildings erected separately. This would mean that the field for possible benefit to the laboring man in the purchase of a cheap cottage of good design and material would be immensely greater than under any system in which the economy would be accomplished only by the building of a great number of dwellings at one place and time.

Third. The structure may be built by the use of skeleton sections, or what might be called permanent molds,† manufactured at or near the site, and filled with cement after erection "in situ." Under certain conditions it would appear to have many advantages, saving as it would the great expense of the temporary molds assembled at each building and the necessary transportation of them, while at the same time permitting the use of machinery and continuous production in a factory, and reducing the expense of transportation of the sections and their handling, by reason of the fact that they would be practically only shells until filled with concrete in the building.

A careful analysis of the problem of economic building shows the following requirements:

a. The maximum possible adaption of design to the most economic methods of building construction.

b. The adaption of materials and methods of construction to the latest and most efficient mechanical devices, meaning the minimizing of hand labor.

And to this end that the solution consequently involved:

c. The re-adjustment of the building unit with the object of reducing the number to the minimum and increasing their size to the maximum compatible with economic duplication and handling.

d. The adoption of a system of shop manufacture with its possibilities of standard economic conditions of all kinds.

e. The maximum consolidation of processes in manufacture, meaning the further elimination of waste—time, labor and material.

f. The maximum of standardization in design compatible with certain practical and aesthetic standards—meaning still further economy in cost of plant and mechanicism required for the manufacture and erection of the units.

Paragraph *c* above is the mechanical problem involved in handling economically concrete building units. We have seen various developments of this in every line; wall blocks used to replace a great number of brick, expanded metal and plaster board replacing small unit wooden lath. At every point possible larger units are used to replace smaller component parts at a saving in labor.

What is of interest in this connection as a practical working out of what has been proven experimentally and theoretically, is the independent and original work done in Los Angeles, by Thomas Fellows, to whom, together with the *Southwest Contractors,* we are indebted for the following notes and illustrations.

Mr. Fellows, it seems, took up the subject of constructing fireproof houses at low cost in connection with the work of the City planning Commission and an opportunity for practical demonstration of his ideas was afforded when a movement was started to erect a home for the widow and children of George A. Merrill, a laborer killed while in the employ of the city by the caving of a gravel bank. Mr. Fellows offered his services gratis in planning and superintending the erection of a model concrete house and through the solicitation of Mrs. A. I. Bradley, head of the Bethel movement in Los Angeles, and other charitable workers, a lot and all the labor and materials for the structure have been donated. The site is a hillside lot on Branch Street, two blocks north of York boulevard, just outside the city limits.

The house is shown in various stages of construction in the accompanying illustrations. In designing the house classical lines were followed because they are most readily adapted to concrete construction. This should not, however, be considered the limitation in the matter of architectural style.

In construction Mr. Fellows has chosen the unit system as tending to greatest economy, but he has so assembled the various parts as to make practically a monolithic structure. The house as planned and constructed, Fig. 1, is one-story, 25 x 26 ft., and contains four rooms, bathroom, pantry and large closet. There is a concrete terrace across the front. The cost, computed at market rates for both labor

*"Cement Age," December, 1910.

†Compare "Cement Age," February, 1911, page 62, "Concrete Caissons and the Lesson Therefrom."

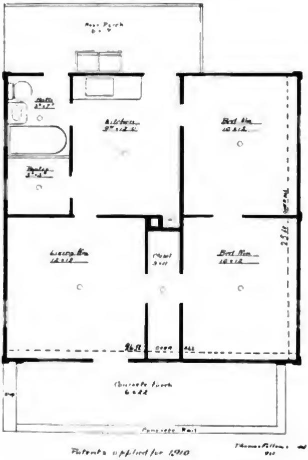


FIG. 1—FLOOR PLAN, MODEL CONCRETE HOUSE.

and material, is about $1,200, or about 10 per cent greater than the cost of a frame house of the same size and design.

The foundation was cast in wooden forms in the ordinary way. The walls and partitions are made up of slabs cast upon the ground and set in place by means of a derrick after being thoroughly cured. It is in the casting of these slabs that the greatest economy is secured, for it saves the cost of a large amount of lumber and labor used in making forms.

The foundations are 8 in. thick, the outside walls 3¾ in., partitions 2¾ in. and the roof slab 4 in. All these members are reinforced with No. 24 American steel wire fabric. City building ordinances do not permit the use of 4-in. reinforced concrete bearing walls, but as the house is outside of the city limits, there are no restrictions operative save those imposed by the judgment of the engineer, who has a due regard for safety. A 4-in. concrete wall properly reinforced is regarded by the designer as sufficiently heavy for a one-story building and it is not improbable that council will be petitioned to amend the ordinances to permit its use.

The wall and partition slabs were cast on the ground at the side of the house, the method being very simple and inexpensive. (Fig. 2.) First the ground was made level and rolled to hard surface. The only forms used were surfaced timbers, 2½ in. sq. for partitions, and 4 in. sq. for bearing walls. These timbers were either afterwards removed or remained attached to the slabs, forming the jams of door and window frames. Strips were nailed on the inside of these forms to make a channel in the edges of the slabs. Lag screws were inserted in the frames 2 ft. on centers. These held the timbers used for frames in place; otherwise the lag screws were removed and eye bolts set in their place, to make the connections between the slabs and at the corners, steel rods being dropped down through the rings and thoroughly grouted in. This connection makes a practically monolithic structure.

In casting the wall slabs a mixture of 1 part of cement to 5 parts of river gravel was use. First a layer of 2½ in. of wet concrete was poured, then the steel fabric reinforcement was set and the form filled with concrete to within ¼-in. of the top. The finished surface composed of 1 part of cement to 3 parts of fine texture material, was then laid. In this case crushed dark granite was the texture material, making an attractive surface that renders a plaster finish unnecessary. This texture method makes possible a varied treatment of the exterior of the house. A similar method was followed in casting the partition slabs, omitting the texture mixture. Sixteen days in summer and three weeks in damp weather is sufficient to cure the concrete slabs before setting them in place.

The roof slab is cast monolithic, the flooring, shored up by the ceiling joists, being used for a form. The wire fabric was also used as reinforcement. The roof slab is supported by the outer walls and a partition through the center of the building.

The advantages of this system of construction are that the cost of labor is reduced to a minimum, most of the work being done by unskilled workmen; uniform strength of walls is easily procured when

FIG. 2—METHOD OF CASTING AND RAISING WALL SLABS FOR MODEL CONCRETE HOUSE.

FIG. 3—PHOTOGRAPHS SHOWING HOW WALL SLABS ARE SET IN PLACE.

they are horizontally poured; the cost of the outside plastering amounting to six cents per sq. ft. is saved, and the cost of forms reduced at least four cents per sq. ft. over the ordinary method.

The house will be neatly and substantially finished inside and out with casings at all openings.

Thickness of walls, floor and roof slabs and reinforcement is a matter to be determined by calculation in every case. In the Merrill house the floors and cornice will be wood, but may be made of concrete at a relative increase of cost. This system of construction should be not only practical from all points of view, but also susceptible of wide variation in architectural design.

FIG. 4—MODEL CONCRETE HOUSE LOOKING DOWN ON ROOF FROM HILL SIDE.

A Large Concrete Flume

The natural resources department of the Canadian Pacific Railway has made the announcement that the contract will be let for what is said to be one of the engineering feats on the American continent. It is for the construction of a concrete flume $2\frac{1}{2}$ miles long, 10 ft. wide and 10 ft. deep. It will be erected on pillars some 16 ft. in height. It is to be built in connection with the company's irrigation projects at Bassano, Alberta, and will be used to carry water across a valley $2\frac{1}{2}$ miles in width. It will be the main waterway of the system.

FIG. 5—FRONT VIEW OF MODEL CONCRETE HOUSE.

PRE-CAST CONCRETE RESIDENCE CONSTRUCTION

A MODERN residence embodying rather unusual features is now being completed at Woodmere, Long Island, for Antonio Zucca, one of the leading Italian-Americans of New York. The design, by Geo. V. K. Greene, is pure modern Italian, and when completed, will present a worthy example of careful artistic appreciation, interpretation, and detailed execution.

This house, as shown in the accompanying drawings, is about square. The plans show the layout in detail. A feature of particular interest is the "altana" extending across the entire front of the third floor. This large upstairs sunny living room is distinctly a feature of Italian design.

The structural features are of pre-cast concrete throughout, with the exception of the footings, the basement floors and a lintel or two.

All walls are of concrete tile,* and where bearing was required, the tile, set on end, are filled with a gravel concrete, using about a 1 to 16 mix. Such filled walls are used throughout the basement to the first floor line. Walls above this are hollow.

All floor beams are a pre-cast concrete joist known by the trade name of "Ribcrete,"† and were described in detail in CEMENT AGE for August, 1911. These joists, as shown in the accompanying views,

FIG. 1—RESIDENCE OF CONCRETE TILE DURING CONSTRUCTION.

are essentially 2x10 ins. in section and weigh 23 lb. per lineal foot.

The ceiling is formed by dropping bevel-edged concrete slabs between the joists to rest on the lower flange. Where wood finish floor is used, the subfloor is nailed to a strip embedded in top of concrete joists. Where tile or terrazo floor is used, unit slabs, identical with those used for the ceiling, are

*Manufactured by the Concrete Products Co., of New York at their Flushing plant under the Paully system.

†Manufactured by the Concrete Products Co., of New York.

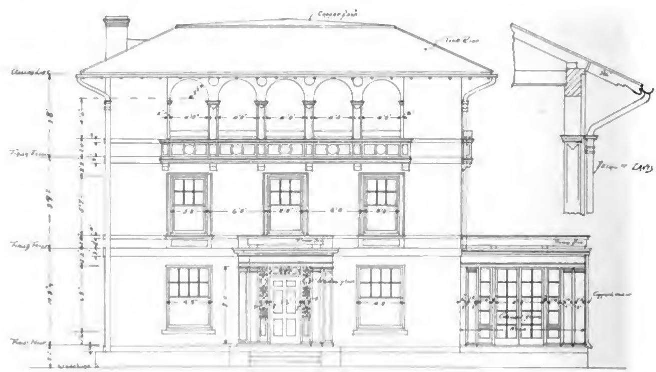


FIG. 2—FRONT ELEVATION OF THE ZUCCA RESIDENCE AT WOODMERE, L. I.

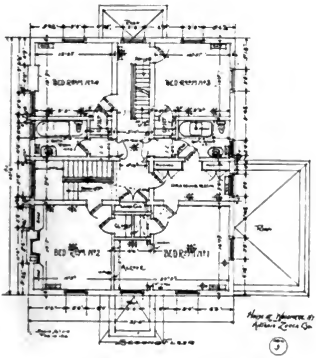


FIG. 4—FIRST FLOOR PLAN.
Concrete Tile Residence, at Woodmere, L. I.

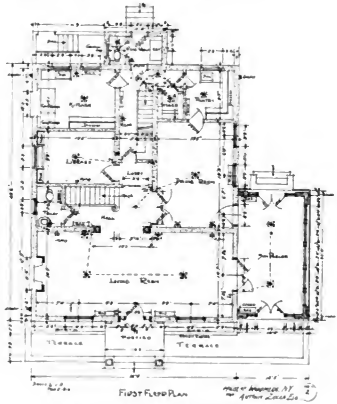


FIG. 5—SECOND FLOOR PLAN.

placed between the joists resting on the top flange. On top of this an inch or so of concrete is placed as base for terrazo or tile finish. The roof is timber frame, with copper deck and tile slope.

All the interior walls are of 8 and 4-in. concrete tile, making an absolutely fireproof structure.

The holes in the concrete joists make for easier handling, and in place in the floor, furnish openings for pipes, etc.

This floor construction has the weight and stability of steel erection, with the adaptability of timber work. Walls are built as usual, and beams are placed and seated accurately, and a strip is laid across the top to hold the beams in position.

A garage is built using in general the same construction. An interesting feature of the design is that provision was made for future use of horse and carriage by providing head windows for stalls, loft doors and manure pits.

The outer surface of the entire structure, both residence and garage, will be covered with "Asbestic"* stucco. The concrete tile already presents

*The Johns-Manville Co., New York.

FIG. 3—SIDE ELEVATION OF THE ZUCCA RESIDENCE.

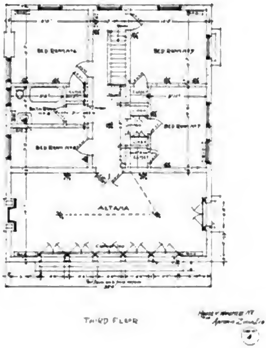


FIG. 6—THIRD FLOOR PLAN SHOWING "ALTANA."

a very good appearance, and if stucco had not been required to carry out the Italian design, the structure could well be left with its present surface. The concrete tile presents a broken, pleasing mouse-colored surface of various shades, which are very pleasing.

Plaster will be applied directly to the inner surface without furring.

At the southern side, the solarium is built, with a concrete floor laid directly on gravel fill. Fireplaces are built into the front chimney at each floor level.

The lintels in general were made by placing three or four tile on end, one above the other, inverting a reinforcing rod in one side and filling it with a good grade of concrete. Some of the larger lintels were of solid concrete cast in wooden forms either in the yard or in place. In the basement and across a large opening on the main floor structural steel I-beams were used.

The total cost of the house, including the garage, approximates $20,000. G. V. K. Greene, the designer, executed the work throughout.

In every way this construction presents most interesting features. The work is not affected by cold weather, and as some of the illustrations indicate, this structure was under way in winter. With a centrally located plant to produce concrete units the economy of such construction would not depend on the size of the structure, and the small house as well as the large mansion could be built. This is really a most important factor, as heretofore it has been held that the great economies of reinforced concrete can not be developed in small construction,

FIG. 7—THE ZUCCA RESIDENCE DURING CONSTRUCTION.
The concrete joist are in place, ready for slabs or flooring.

FIG. 8—THE GARAGE OF THE ZUCCA RESIDENCE.

The texture of the concrete tile is very pleasing, and stucco is required only to carry out the Roman architecture.

and in many instances, this has been true. Concrete "lumber," however, with wall units, should make possible economical construction in all types of structures.

Bond

One of the most useful parts of the interesting paper read last month by W. C. Popplewell to the Institution of Civil Engineers was that relating to the experiments made by him to determine the adhesion between concrete and embedded steel. The tests conducted by the author on concrete of decidedly poor quality, as shown by its ultimate compressive strength, showed that for bars embedded from 10 in. up to 40 in., the first sign of failure in the case of the more deeply embedded specimens occurred at the yield point of the steel, that part of the bar within the concerte remaining firm and showing no sign of movement. The experiments resulted in adhesive values in tension ranging from 243 lb. per sq. in. and as Mr. Popplewell mentions, the values would be considerably higher in compression as the effect of stress then causes increase of diameter tending to tighten the grip of the concrete. We hear so much in the present day from interested sources as to the desirability of mechanical bond, that it is distinctly useful to have still another authoritative statement of the fact that in columns reinforced with plain round bars there is no evidence of movement of the concrete relatively to the steel. This conclusion expressed by Mr. Popplewell is supported independently by the experiments on the adhesion bond between the two materials.—*Ferro-Concrete.*

Iron Preserved in Concrete

The accompanying illustration is reproduced from a sketch sent to the Concrete Institute, together with the bolt itself, by Messrs. William King & Son, builders, of 3, Vauxhall Bridge Road, Westminster, S. W., and was published in the current transactions of the Concrete Institute.

This rag bolt was found, in the summer of 1911, embedded in a slab of concrete composed of Portland cement, ballast, and broken bricks , in the position shown on sketch. The concrete formed part of the foundations of the 1862 Exhibition buildings at South Kensington, and had not been disturbed up

SKETCH SHOWING HOW BOLT WAS IMBEDDED IN CONCRETE.

to the time of its removal. The bolt was found when cutting through the concrete slab for some alteration in connection with the Imperial Institute, and was at ground level. A floor has been constructed about 2 ft. above this level, so that this concrete and bolt were under cover. The bolt sent was one of many found, and it was thought they had bolted down machinery. Only the top end where exposed to air and the bottom end where embedded in soil were corroded; the remainder was quite clean, with the original blue scale thereon.

At a convention of the Iowa Ice Dealers' Association at Waterloo, Iowa, during March, a committee was appointed to investigate and report at the next meeting on the use of concrete for the permanent construction of ice houses. This committee is to work in conjunction with the Information Bureau of the Universal Portland Cement Co., and the report is to be published at their expense for wide distribution. This co-operation, by bringing together practical ice men and trained concrete engineers should result in a standardization of ice house construction materials.

SMALL UNIT CONSTRUCTION

A UNIT construction possessing features of unusual interest has been developed by John O'Donoghue of Jersey City, N. J. So far, effort has been directed in the main to building one-story bungalows and garages, but the same procedure could be easily applied to larger buildings.

In this system, pre-cast columns and slabs are used. The columns so far have been as shown 5½ in. x 8 in. in sections, and slotted as detailed. The wall boards are 1¼ in. thick, 10 in. wide over all, ship-lapped as shown, with 9 in. to the weather.

In building a small building, such as a garage, footings are placed directly against the proper excavation, following usual practice in this line. Columns are placed 4 ft. on centers. In practice, a high saw-horse is placed across the line of the wall, between each column, and horizontal sway-braces, and line strips are nailed to these. The sheathing "boards," are then slid in the groves and the wall sided up as required. Window casings are detailed so that a column comes on each side, and the "boards" are only brought to the bottom of the window casing. Timber roof rafters are detailed over a 2 x 6 strip, following usual practice.

In the work so far completed, which has been several garages in Jersey City and vicinity, the exterior has been treated with stucco, and the inside plastered directly on the units.

In casting, the columns are poured in a horizontal position, with the exterior face down. The wall "boards" are cast on edge in a multiple form arrangement.

The accompanying sketch (Fig. 4) shows a bungalow which Mr. O'Donoghue is planning to erect for himself. No detail cost data is at present available, but it is estimated that four men could cast all the material required for such a bungalow in about 5 days. The complete erection of all the concrete work by the same four men should be done in three days. The essential point in such construction is probably the development of economical and efficient forms in which to cast the units. Mr. O'Donoghue's efforts have been directed along this line mainly, and so far, have been successful.

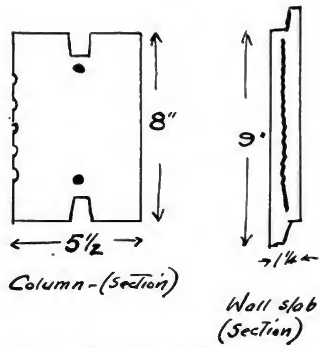


FIG. 2—SECTIONAL DETAILS OF COLUMN AND WALL SLAB SHOWING GENERAL ARRANGEMENT.

FIG. 1—A GARAGE AT JERSEY CITY, BUILT OF PRE-CAST CONCRETE "LUMBER."

Such a system is possible of much development, but even in its present state, offers much of interest to the small house-builder.

Roofing Felt on Concrete Floors

Although there may be no danger of permanent physical disorders arising from working on cement floors, some feel more fatigued at the end of a day's work than where a softer floor covering is employed, says the *American Machinist*. A good way to offset the undesirable features of cement floors is to lay, at such places where men stand at their work, sheets of 3-ply roofing felt which can, in warm weather, be cemented to the floor with the same kind of cement used in making the joints on the roof. This covering lies flat, is easily swept, is pleasant to work on and wears surprisingly well considering the character of the material. At places where men spend a great part of their time the covering will give good service for 10 or 12 months. The price, too, is greatly in its favor, as the cost is less than $3 per hundred sq. ft.

FIG. 3—A LINE WALL BUILT WITH CONCRETE UNITS.

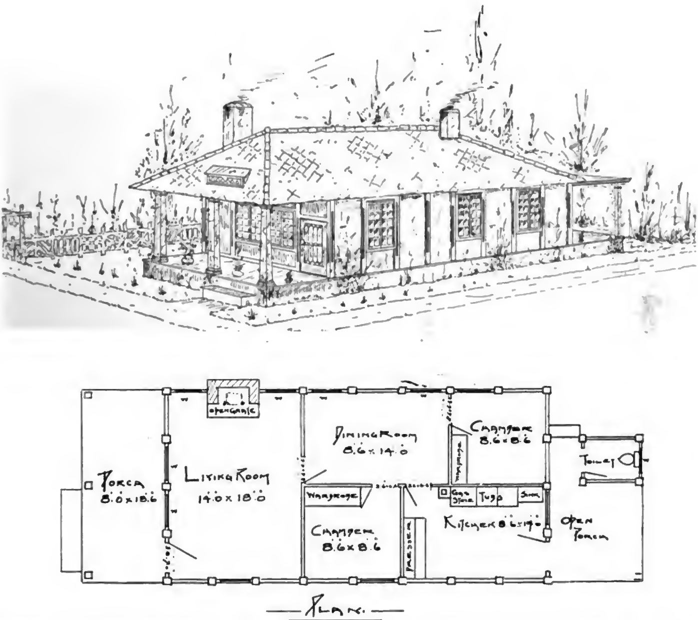


FIG. 4—PERSPECTIVE SKETCH AND PLAN OF CONCRETE BUNGALOW USING PRE-CAST UNITS.

ADAPTABILITY OF CONCRETE TO VARIOUS ARCHITECTURAL TYPES

THE accompanying pictures are presented to show how feasible it is to have variety in the design of concrete dwellings, in brief, that concrete construction need not be confined to a single type. It is not urged that these examples represent the best that architects can do. They are shown to emphasize the fact that concrete, in house construction, may be treated in many different ways without sacrifice of structural stability or worth. The houses shown include various methods of construction from stucco to solid walls.

FIG. 1—ROOF AND CHIMNEY A CONCRETE MONOLITH. NO FLASHING REQUIRED.

Fig. 1 is especially interesting, owing to the concrete roof and chimney. By the use of concrete in this fashion there is avoided what is very frequently, an annoying detail to builders, namely, an absolutely weather-tight condition where chimney and roof meet. In this concrete roof no flashing is required, roof and chimney being a monolithic mass. The picture also sug-

FIG. 2—WHITE PORTLAND CEMENT WITH SIMPLE MOSAIC DECORATIONS IN COLORS.

FIG. 4—A NOTABLE EXAMPLE OF THE COMBINED EFFORTS OF THE ARCHITECT AND ENGINEER.

gests great opportunity for improvement in the appearance of roofs by the use of concrete, which may be made to partake of the free lines of the thatched roof, resulting in a picturesque as well as durable and fireproof covering.

Fig. 2 shows a decorative design. This style of decoration is being developed with the most satisfactory results by combining tiles or mosaics with either concrete or stucco. In this case the exterior surface was treated with Berkshire white cement. The massive porch columns or pilasters do not require any ornamentation other than the simple mosaics shown in the picture. Decoration of this kind is not expensive and a very small area so treated is quite as effective as more elaborate work.

Fig. 3 is an especially interesting example in that it shows two distinct surface effects, one of plaster and the other an untreated concrete surface. The walls of the house have been plastered while the foundation or walls of the conservatory has been left practically as it appeared when the forms were removed. The solid concrete wall of the conservatory conveys a sense of greater durability than the plastered house wall. It is this sort of wall that represents the minimum of cost and maximum of strength. There is little doubt but that architects will come to regard this type of surface as entirely appropriate for a house.

In Fig. 4 we have a notable example of recent progress in dwelling construction as representing the combined efforts of the architect and engineer. The construction of a large concrete dwelling is distinctly within the province of the engineer. This handsome house was built in Detroit from plans by Albert Kahn, architect. A few years ago concrete would not have been considered as acceptable for any feature of a house of this class.

FIG. 3—AN UNTREATED CONSERVATORY WALL WHICH CONVEYS A SENSE OF GREATER DURABILITY THAN THE PLASTERED HOUSE WALL.

THE YEAR'S DEVELOPMENT AND FORECAST

By Rolf R. Newman*

DURING the past year the heavier uses of concrete, such as the locks at Panama, the structures of the New York aqueduct** and a multitude of large buildings, bridges, docks, etc., have stood out more prominently than have the examples of concrete residence construction. However, as this number of CEMENT AGE will indicate, no branch of the industry has failed of development and this most important question of permanent concrete houses has not been neglected.

I have often noticed that when a large concrete structure has been erected in a locality, a multitude of smaller concrete structures have soon followed. Many of the local workmen trained in the use of concrete on the large structure have put their new found information to practical use about their own simple houses. I know this to be true about the great plant of the United Shoe Machinery Co.† in Beverly, Mass., and have noted it in many other parts of the United States.

It needs no great foresight, therefore, after a year of tremendous concrete undertakings to prophesy, with the deepest faith in its fulfillment, that the next two *years* will see more concrete houses built than have been erected in the past two *decades*. Also I believe that within five years one third the product of all our cement plants will be going into concrete houses and where one concrete house stands to-day a thousand will stand five years from now.

A year ago‡ I said that we should "standardize our present methods and inventions" and that there were "too many designs in existence and not enough practical application of the best possible design." The printed evidence regarding concrete houses built during the past year has borne out my statements and the presence of practical steel form has still farther tended to standardize concrete house construction.

As to the relation between the so-called "big job" and the smaller application of concrete two facts should be well understood.

First: The contractor's plant applicable for the construction of the big job is not applicable to the smaller jobs and a certain class of large contractors cannot understand how small jobs can be economically operated became their experience has been wholly with the "big job" contractor's plant.

Second: Many smaller details of the plant used on the "big job" are applicable to the small house plant and when a contractor has properly familiarized himself with the needs and proper outfit for concrete house construction it can be done proportionately as economically as can the "big job."

In short, there is no more reason for a man trained in the larger applications of concrete to decry its use for small structures than there should be for a local builder trained say in concrete block work to deny the practicability of a long span concrete arch. All concrete interests

FIG. 1—LARGE AND SMALL CONSTRUCTION IN CONCRETE.

The upper view shows the $1,000,000 plant of the United Shoe Machinery Company, which furnished an employee the inspiration and experience to build the Gate House shown below for $300. This in brick would have cost $700.

*Pasadena, Cal.
**See "Cement Age," January, 1912.
†The structural features of this plant are described in "Cement Age" for March, 1911.
‡"Concrete Dwelling Houses, A Summary of Progress," by Rolf R. Neman, "Cement Age," May, 1911.

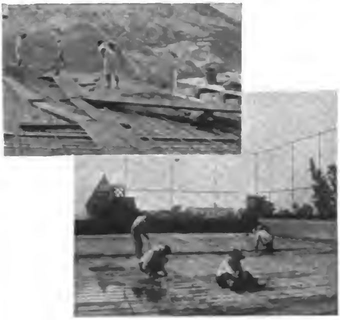


FIG. 2—CONCRETE ROOF CONSTRUCTION.

The roof shown in the upper view was part of a $200,000 extension to the plant of the Riverside (California) Portland Cement Company, and furnished the confidence and experience for constructing the $650. roof shown below.

must become more closely knit together and "high-priced supervision" must join hands with the "cement workers'" skill in winning the concrete victories in the interest of *permanent American homes.*

Where Concrete Solved a Difficult Problem

Engineering News describes an unusual form of foundation adopted recently in constructing a high-class residence in Pittsburgh in a location where the ground was known to contain old coal-mine workings at some distance under the surface. Since a great part of the city is underlain by such old workings, the condition is not an exceptional one, but ordinarily no means for protection against possible future caving of the workings are thought necessary. In this instance, however, the workings were near the surface, and the owner preferred to protect himself by carrying the foundations through the workings into sound rock below. The following describes the case in brief:

In preparing for the construction of a residence for O. M. Reif, at Beacon St. and Shady Ave., in the Squirrel Hill district of Pittsburgh, exploratory holes were drilled to determine the extent of undermining by coal workings. The workings were found at depths of 35 to 55 ft. below the surface, with shale and sand-stone overlying. The workings did not seem to be open and free of debris, indicating that the roof had fallen in the past, and it was considered quite likely that future caving of the roof and possible surface subsidence was to be anticipated. The owner therefore planned to sink concrete columns through the overlying rock and the workings, footing them in the solid rock below, and to support the house on girders carried by these columns. The work was designed and executed in accordance with this plan by the Cummings Structural Concrete Co., of Pittsburgh. A ground plan of the house and a concrete girder are shown with other details of construction.

FIG. 3—THE BISHOP'S SCHOOL FOR GIRLS, SAN DIEGO, CALIFORNIA.

A genuine concrete structure suggestive of the utmost safety and permanence.

Silos

John Rivers, Auditor of the L. P. Dolliff Lumber Co. of Minneapolis, overheard a farmer talking with a wood silo salesman. After the salesman had talked at some length, the farmer asked whether he would be able to put up this wooden silo himself. A farmer standing near said, "Sure you would, I have put mine up eight times in the last three years." This conversation occurred at Norton, Minn., but, this trouble with wood silos is happening everywhere. There is only one silo which does not require tightening up of the bands, which does not require insurance and that is the concrete silo.

Ventilation

The question of proper ventilation is an important one in concrete residences. In other construction there is a considerable air leakage through the walls and floors. Concrete, however, is windproof, which is of advantage, but ventilation must be provided in these buildings, if they are to prove healthful. For inexpensive homes of concrete specially adopted design for ventilation is essential.

Railroad Bridge Details

Reinforced concrete floors on some double-track bridges recently built have longitudinal joints between the tracks, says a contemporary. The engineers state that, when these joints are omitted, the local deflection when trains pass over one track produces stress in the concrete that cause cracks to appear in the structure. In some cases the concrete for the two tracks is laid independently, the two surfaces merely abutting at the joint. In others the joint is formed by some elastic medium placed between the two surfaces, thus giving a sliding joint. It is stated that with the latter construction a perceptible movement at the joint has been observed.

FIELD-MADE CONCRETE MIXERS ON AN INDIAN BRIDGE

THE Afzalgunj bridge, forming the main approach to the city of Hyderabad, Deccan, India, a masonry structure, was partly destroyed by flood in 1908. New arches of reinforced concrete were used to replace the destroyed portions of the structure and Marsland, Price & Co., Ltd., of Bombay, designed and built the work, which consisted of four elliptical arches of 54 ft. span, and 9 ft. used. The piers were of solid reinforced concrete of a 1:3:5 mixture, suitable bonding rods being left in same to project into the haunches of the arches. The arch rings, which are built of a 1:2:4 mixture, had a double row of corrugated bar reinforcement placed about 2 in. from the intrados and extrados respectively. These bars, which were 1 in. square, were spaced about 10 in. apart and the two rings connected with binding every 3 ft.

The reinforcement in the extrados of each arch was carried across to join the reinforcement in the extrados of the adjoining arch. No hinges were introduced but work was stopped over the center of the piers, continuous work being done until each arch was completed.

Each arch ring was 15 in. thick at the crown and about 2 ft. at the haunches, which were afterwards filled in with a weak cement concrete mixture. Bonding rods were left in the work to receive the railing standards.

A feature of more than usual interest was the use of a field made rolling drum for conveying and mixing the concrete. A letter from Lalubhai, Samaldas & Co., the representatives of Marsland, Price & Co., Ltd., enclosing the description of the drum, says, in part:

"We had no mixing machines available and so we had to use the next best under the circumstances, and these we found acted exceedingly well. Machine mixing would not only have cost money to install, but we would have had to have employed special men to work the machines, but in this case the ordinary coolie—which is the Indian term for a laborer—was able to work these machines and we had a constant stream of them running from the depot where the cement, sand and crushed stone was stacked to the bridge itself and all the time the concrete was being mixed thoroughly.

"We would strongly recommend this class of mixers anywhere where there is difficulty in getting machinery as there is in this part of the world. The fact that the bridge turned out a great success is one proof that the mixing was done thoroughly well."

The descriptive specification for this rolling drum received from the constructing engineers, is as follows:

FIG. 1—CONCRETE BRIDGE CONSTRUCTION IN INDIA.
The concrete is mixed and transported in small rolling wooden drums.

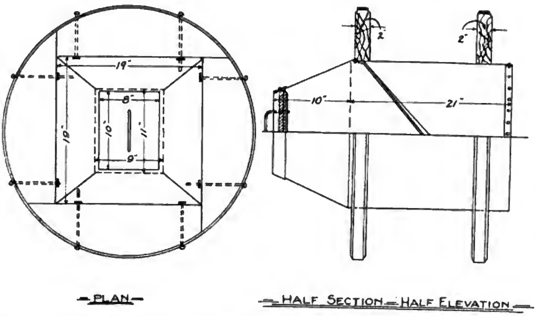


FIG. 2—DETAILS SHOWING CONSTRUCTION OF SMALL ROLLING MIXER.

DIMENSIONS: Over all 31 in. by 19 in. square at one end and tapering for 10 in. of the length at other—the mouth at this tapered end being 10 in. by 8 in.

BODY: The body is made of 1/16 in. black sheet iron riveted along one side—the bottom being a pressed plate of similar thickness and the taper end cut and so riveted that the joints here and at the bottom and sides are practically water tight. Inside the body a cross bar 2 in. by 1/4 in. is riveted diagonally. This is not absolutely essential and as it is in the way when cleaning the drums after use, it had probably be better left out.

WHEELS: Wheels are 33 in. diameter and 17 in. pitch, one wheel being about 3 in. from the square end of the drum and is made of four panels of well-seasoned and dried wood, tapering from 1½ in. under the tires to 2 in. at the drum. On these panels a hoop of bar iron 1½ in. by ¼ in. was shrunk, and countersunk bolts were passed right through both the tire and wooden panels to the inside of the drums. The ends of some of these bolts were left projecting into the drum and assisted in the mixing, check nuts of course being used to secure the bolts from working loose.

STOPPER: Ordinary soft pine wood was used in 2½ in. layers placed sandwich form and riveted together, the edges were rounded so that when the stopper was put inside and brought against the taper sides of box it fitted evenly. The stopper had a steel handle riveted through same to help in getting it out.

OPERATION: The drums were placed in a line resting on their bottoms and men appointed to fill in stone, sand and cement in the proportions required. These materials were brought up in small buckets or "Gamellas," as they are called, and placed on a stand behind the drums.

After the drum was filled with the measured quantity of materials forming the aggregate about 12 to 14 per cent. of water was added. The stopper was then put in side-ways and turned quarter round.

One of the men required for rolling the drum held this stopper and when it was put into the drum he and his mate tipped it over onto its wheels. The action of doing this caused the material to fall against the stopper and so kept it in place. Nothing more was required until the mixture was ready for discharging at the other end of the run when the stopper was pushed in, turned quarter round and withdrawn.

"H" steel beams were used for the drum tracks and planks suspended between these beams for the men to walk on.

The concrete was dumped from this track, the beams catching the necks of the drums and so preventing them falling through. The rails should be about 18 in. above the top of the concrete when the drums can be tipped most advantageously.

The distance the drums should be rolled is about 40 to 50 ft. when the concrete will be found to be properly mixed, but if possible it is better to make the run about 60 ft. If the distance is short, then the drums should be rolled forward, then backward to make up the required limit.

The drums held about 3 cu. ft. each.

The plan adopted was to have two lines of "rails" at suitable distances apart, so that the full drum was tipped and then turned over on to the line for returning the empties.

We found it necessary occasionally to scrape the bottom of the drums, and always on finishing work to have them thoroughly cleaned with water, otherwise the deposits left harden and so interfere with the filling of the drums to the required amount.

Want to Know About Concrete?

The *Architect and Engineer*, of California, has opened a new department for young draughtsmen. The purpose is to have them send in inquiries concerning the problems they may encounter. In the first issue containing the department, fifteen questions were presented, and it is significant to note that six of them related to cement and concrete construction. In other words nearly half of the queries were confined to the use of a single material, showing that interest in cement construction mixture was ready for discharging at the other is firmly established in California.

Before removing forms, one large builder—C. A. P. Turner—requires that a 20-penny spike driven into the concrete must double up before it has penetrated one inch.

STEEL FORMS AND THE POURED CONCRETE HOUSE

By Wm. Mayo Venable, A.S.C.E.*

The development and successful use of steel forms for concrete wall construction is making possible monolithic concrete wall construction at a very low cost, and the following analysis of the advantages of steel over wood is of much interest and value.

THE number of poured concrete houses constructed has been steadily increasing from year to year, there being two distinct lines of development which have been followed:

First: There has been the application of reinforced concrete to large residences on country estates, erected by wealthy people in whose eyes permanence of construction and fireproof qualities have been considered of such importance as to make the matter of cost subordinate and comparatively insignificant.

Second: There has been a development of reinforced concrete buildings for workmen's houses, in which permanence of construction and fireproof qualities have been considered important by the investing owner, although low construction cost has also been of the utmost importance.

In other words, concrete has been applied more to the most expensive kind of construction and to the least expensive kind of building, and the number of houses of intermediate cost has been comparatively small. The construction of the workman's cottage of concrete can be reduced to a cost competitive with that of brick or first-class frame buildings only where the cost of the forms for the concrete work is reduced to a minimum and where restrictions of building laws do not require unnecessarily great thicknesses of walls.

Wherever the concrete house is considered as a modification of the frame house and is governed by the building laws formerly applied to frame houses, it competes favorably in cost; but where it is considered as a modification of the brick house, and the thickness of the walls are based upon building laws governing the thickness of brick walls, it usually cannot compete favorably in cost. Thus, our building laws, not considering the use of concrete upon its merits, in most places, have not provided just and reasonable requirements for concrete residences; and building laws often act as an obstacle to prevent owners from constructing concrete houses.

Any competent estimator can figure the cost of the materials which enter into a concrete wall. In a general way it is less than the cost of materials in a good brick wall of the same dimensions, and greater than the cost of materials in the walls of a corresponding frame house. Any experienced concrete worker can also make an approximate estimate of the cost of labor required to place the concrete in the form for the house, but there are comparatively fewer persons who can figure with accuracy the cost of the forms for concrete houses when these are made of wood. The walls of a house must be perfectly true; otherwise, the appearances will be extremely displeasing. Slight variations from true surfaces may be tolerated in foundations, but they are fatal to the appearance of superstructures: consequently, the cost of house forms for walls, when forms are made of wood, is excessive, compared with the cost of wooden forms for other classes of work, and the wooden forms—as a rule—produce surfaces which demand subsequent treatment of some kind, usually an expensive treatment, such as rubbing down with carborundum, or the application of stucco. Simpler treatment can be applied, or treatment can be omitted altogether only in those cases where the forms are sufficiently strong and true and smooth to produce the proper surfaces when the concrete is poured.

Steel forms have been applied on engineering construction very extensively during the past six years. It has, in fact, been almost the general practice to use them on sewer work, large and small, all kinds of conduit work, subways, shafts, tunnels and retaining-walls.

The application of steel forms to building construction has come more slowly, the principal reason being that the forms for building construction must be lighter than those for the heavier work and that the advantages in cost arising from their use have not hitherto been fully appreciated by the builders, the contracts being smaller. The great variety of designs of buildings has likewise operated to retard the application of steel forms to this work. For house building the economy to be secured by the use of steel forms is pronounced. Where the walls are composed of plain surfaces, adjustable steel forms can be used on a very wide range of work. These forms can be used over and over again, not only on many buildings in succession, but several times over on one building only.

The advantage of steel as a material for construction of a form resides in its very great hardness, rigidity and impermeability. A steel panel holds its shape no matter how many times it may be used, providing it is not strained beyond the elastic limit of steel. It does not stretch when wet or contract when drying. If the form is kept clean the concrete surface is always smooth. The steel form, if composed of panels, when assembled, is always of the same dimensions. Panels do not warp while being shifted, and consequently, the panels themselves,

*Pittsburgh, Pa.

with the necessary auxiliaries for connecting them together, may be used as templets for the construction of the house forms, eliminating external bracing altogether, and in fact, eliminating the labor of "lining up" after the forms are assembled. Thus, it is possible to reduce the labor on forms for house construction to less than 1 ct. per sq. ft. of wall surface* where steel forms are used; whereas, the cost of labor for erecting wooden forms for that work, can scarcely ever be reduced below 5 cts. per sq. ft. of wall surface. Where steel forms are employed on house construction, they are made up of panels of moderate size, which can readily be connected together, so as to form surfaces of any desired area. In building a house, it is usually desirable to provide forms sufficient to go entirely around the outside and inside of the walls of the house and the partitions, if these are to be of concrete, but these forms need not be over four or six feet high, being made up of courses about two feet high. As soon as four or six feet of forms have been filled with concrete, the bottom row of plates may be removed and placed on the top and the concreting continued. The wall is carried on up in this way for any height desired. Where wooden forms are used it is not practicable to assemble them in this way, because they are too flimsy to secure true alignment, and therefore, in the first place, it is necessary to provide more forms than would be required to construct the same house with steel forms, and it is also very much more difficult and expensive to place the forms. Thus, although forms 4 ft. high will be sufficient to construct an ordinary house wall 28 ft. high, where steel forms are used—and with the steel forms the work will be conducted uninterruptedly and finished in seven days;—if wooden forms were used, they would have to be provided, at least, ten feet high and the work would have to be interrupted while the forms were being shifted.

Assuming that a minimum of 5 cts. per sq. ft. for the labor on the forms for house walls and of 3 cts. per sq. ft. for the lumber lost and damaged will be the cost, we have a total minimum cost of 8 cts. per sq. ft. of wall surface for work of this kind in wood. The writer believes that contractors who have had experience in this work, will agree that the cost more frequently runs above 12 cts. than as low as 8 cts.

The cost of handling steel forms, however, is not likely to exceed 1 ct. per sq. ft. of wall surface, leaving a difference of 7 cts. or more to apply towards paying for the steel forms. Thus, it is evident that whether it will be cheaper to use the steel forms or the wooden forms is only a question of how many times the steel forms may be used over in proportion to their cost on the work in question. The answer to this varies from locality to locality, but in general it may be stated that the steel forms will be entirely paid for by the saving they effect when they have been used five to ten times per panel. Therefore, a contractor who is constantly engaged in building walls of this character for concrete houses, and who will use his panels over again, perhaps 100 times in a season, will pay for his forms by the saving over the cost of wooden forms in a comparatively short time. Or if he has sufficient work to do so that he may regard his steel forms as plant, and charge only a reasonable amount for their use on each job, he will be able to reduce the cost of his form work per sq. ft. of concrete wall surface to about one-fifth of what it would be if he did the same amount of work with wooden forms.

As the cost of the form work on house buildings where wooden forms are used considerably exceeds the cost of placing the concrete, it is evident that where steel forms are used to build concrete houses, the total cost of the concrete in a house may be reduced by a very considerable percentage. The saving in the cost of concrete is, however, but a portion of the saving in the cost of the concrete house where steel forms are used, because the alignment which can be secured with the steel forms and the smoothness of the form surface, makes it possible to eliminate most of the work usually required in treating concrete surfaces subsequent to the removal of the forms.

In the foregoing, it is, of course, presumed that the design of the steel forms used is one which will enable the person handling them to obtain all of the advantages which may be secured from the use of the stronger and more rigid material. In other words, the steel forms must be designed in the first place so as to be adaptable to various purposes for which they are to be applied and so as to automatically secure proper alignment, uniform thickness of walls and smooth surfaces, and with a minimum amount of labor.

Merely to employ steel as a material to build forms without adopting a design applicable to this material, would not result either in the saving desired or in the superiority of the work. Steel forms must be designed and built scientifically, just as machinery should be designed and built. It is not practical to modify them in the field. Patch work with them is out of the question.

The provision of steel forms ought to be considered by the contractor or builder precisely from the same standpoint as the provision of a concrete mixer or other appliance for conducting his work.

*Compare discussion under Consultation 224, page 103.

METAL LATH IN RESIDENCE CONSTRUCTION

By H. B. McMaster*

In the development of our civilization it is an interesting study to note the changing fashions in all things of utility, convenience and adornment. It has seemed an unending "cutting and fitting"; we have tried one thing for a time, abandoned it and again our fancies or needs have restored it to favor.

We now admire the half-timbered house or plastered exterior such as the people of Shakespeare's day were wont to live in. The easy harmonizing of natural color tones with the cement gray perhaps accounts for much of its charm. It is so flexible in design, too, that architects have found it a pleasing and fascinating field to work in and through a very wide use of the stucco type of residence they have disclosed its weaknesses and applied the remedies.

The stucco house with a construction which the best architectural and mechanical practice offers looks when new as substantial as brick, stone or solid concrete; it does not fail perceptibly from year to year, but ages slowly and gracefully.

The wooden building must be repainted or otherwise repaired at regular intervals to keep it tight and sound; even masonery buildings need repointing of the mortar joints, but for some reason the owner is not willing that a stucco house shall be built for him which may require any outside patching or resurfacing, however remotely.

Stucco as compared with brick is rapid in construction. the walls are excellent non-conductors of heat and cold, they are dry and they are lasting. They are permanently self-colored, not becoming shabby but mellowed by age, saving not only the first cost of painting, but the cost of repainting, which is a large item in the life of the wooden house.

Early in a man's consideration of the kind of house he shall build will enter the question of price. To determine the relative cost of various kinds of residence buildings an association of manufacturers last year secured bona fide bids on a series of houses, each one exactly like the others in every particular except the outer walls which were to be constructed of the several materials to be compared. A little modern eight-room house of good design and excellent arrangement was chosen, the original having been actually built near Boston. The average figures taken from five sets of bids were as follows:

Type	Description	Average Bid	Excess over Clapboards	Percentage excess over Clapboards
No. 1.	Clapboard	$6,759.95		
No. 2	Shingle	6,868.80	$108.85	1.6
No. 3	10-inch Brick Wall—Hollow	7,372.48	612.53	9.1
No. 4	12-inch Brick Wall—Solid	7,641.00	881.05	13.0
No. 5	Stucco on Hollow Block	7,187.65	427.70	6.3
No. 6	Brick Veneer on Hollow Block	7,483.16	723.21	10.7
No. 7	Stucco on Metal Lath	6,952.90	192.95	2.9
No. 8	Brick Veneer on Boarding	7,226.44	466.49	6.9
No. 9	Brick Veneer on Studding	7,153.98	394.03	5.8

From this it will be seen that the house with outer walls of stucco on metal lath may cost only 2.9 per cent more than the ordinary clapboard house. Another consideration that it is worth while is the protection afforded by stucco against external hazard from fire. The stucco house is good enough to deserve a permanent roofing of either slate or tile which will last as long as the house and cost no more than would the ordinary shingling followed during the life of the average building by repeated reshinglings.

And here again comes in the appeal to the artistic for no roofing material ages and weathers more beautifully than tile. Laid in the roof with the natural variations of kiln-run materials, instead of being mistakenly selected for unifo-m color, the

*Youngstown, O.

FIG 1—EXAMPLE OF STUCCO ON METAL LATH.
Residence of George Rose, Westbury, L. I. Architects, Hoppin & Koen.

tiles grow richer, softer and more velvety in surface year by year until moss and lichens here and there add the final mellow touch of age. So roofed, the stucco house has the same permanent, old world masonry look of brick or concrete. The average frame house even when built on a liberal sized lot, stands a slim chance in a general conflagration, and but multiplies the hazard to those beyond in the path of a fire.

In recent fires, particularly Chelsea and Bangor, the flames swept great districts, spreading rapidly from roof to roof, the fire brand being to the wood shingle as the spark to tinder.

Cement stucco on metal lath applied to wood studding, following recommended practice has withstood fire and water under tests so severe as to justify saying it will preclude all possibility of the spread of a fire such as might reach a residence district, provided, of course, that the roof is covered with tile, slate or an equally non-combustible roofing.

It is within the memory of this generation that forests were cleared away as incumbrances. This waste of our resources and consequent advance in values has been naturally followed by a turning to the use of other materials than lumber. This condition which is one of the reasons for stucco also obtains in considering the substitution of metal lath for wood in stucco work. Architects are still specifying No. 1 white pine lath from force of habit but there "aint none."

If one quarter of these specifications were filled, the price of "No. 1 white pine" would be so high that metal lath would seem cheap in comparison. Builders have to put in what they can get and architects will continue to take poorer and poorer material as long as wood lath is specified. The wood lath we put on ten years ago was poor stuff. It stained the plaster and warped and shrunk with every change of atmospheric humidity. The wood lath we are now using is higher in price and poorer in quality. The best wood lath will shrink and swell alternately with the varying temperature and moisture; the key on wood lath is far apart so that the plaster depends in large degree on its adhesion to the wood. The expansion and contraction of plaster is very small as compared with wood so that the movement of the wood lath in time breaks its bond with the mortar while the swelling of the wood pinches the key and breaks it.

On the ceilings of bath rooms and kitchens where occasionally exposed to steam it is frequently seen that areas of plaster will drop from wood lath for these reasons.

A condition similar to that fancifully shown in Fig 2 might have been expected because in every building there is moisture which is absorbed by the plaster. This moisture remains at the intervals between the lath, but where it is over the wood lath, it is sucked into the wood. The moist plaster accumulates more smoke and dust than the dryer portion and the outline of the wood lath is brought out in consequence.

The use of any material which has a too great affinity for water may cause trouble when plaster and especially stucco is applied to it. It will pull the water out of the mortar, then it will crack and disintegrate.

The objections to wood lath are not found in metal lath. The key is continuous over the entire back of the wall; it does not absorb moisture; expansion is due only to temperature, and plaster and metal lath expand and contract equally under like conditions.

FIG. 2—SUPPOSE SARGENT HAD DECORATED A WALL PLASTERED ON WOOD.

It is very important when there is a desire to save space to know the space-saving value of the 2 in. solid metal lath partition. Assuming the average room to be 10 ft. x 12 ft. or 120 sq. ft., with 6 in. walls, and 10 ft. 4 ins. x 12 ft. 4 ins. or 127.4 sq. ft. with the 2 in. wall of metal lath and studding, we find there is ever six per cent. more occupiable or rentable space in the building with 2 in. partition. Whether one is lessor or lessee, it is fundamentally a matter of paying a certain price per square foot for shelter. Therefore, the 2 in. solid metal lath partition at less expense increases the return on a building more than 6 per cent. over that where the 6 in. wall is used.

It may not be so essential in the lower priced residence that metal lath be substituted for wood lath on the interior but for exterior work the reasons for the use of metal lath are multiplied. Metal lath for stucco found immediate favor with architects and its use has spread so rapidly that to it much may be credited for the development of exterior plastering.

A proper combination of metal lath and plaster with its good bond will insure an unbroken surface and having said so much, I may consistently be asked "What is a proper combination"?

In formulating a specification for good work we want:

1st. Framing that provides for (*a*) the least movement of the members to strain the plaster wall, (*b*) a wall with the best insulating properties, (*c*) a construction that will protect the residence from exterior fire hazard, (*d*) furring that will insure a complete envelopment of the metal lath, (*e*) construction that will keep moisture from getting back of the plaster.

2nd. Lathing so applied as to give a wall that will have the maximum of resistance toward any tendency to movement of the framing.

3rd. Plastering that (*a*) will not develop cracks, (*b*) protects the metal lath.

[It might be added here that the Association of Metal Lath Manufacturers, of which Mr. McMaster is commissioner, have prepared and published, as noted in previous issues of CEMENT AGE, excellent specifications covering stucco work.—EDITORS.]

A CONCRETE VENTILATING CHIMNEY

AMONGST the many new forms of using cement and concrete, which last year were introduced in Europe, there were two inventions, which undoubtedly will have a big future, as they represent a large number of advantages and deserve attention especially from a sanitary point of view. With these inventions hygienic problems have been solved which have been tried for a long time, but until now could not be settled satisfactorily. These inventions were an improved chimney and a concrete radiator.

A combined ventilating chimney serves two purposes at the same time, first to furnish the fire place, boiler or any heating device with the necessary draft, and second to allow a perfect airing of the dwelling houses, or offices in office buildings, theatres, hospitals, and so on.

This chimney, invented by Schofer, is constructed of a "firestone" concrete, that is a mixture of crushed bricks and cement. The brickyards find in this manufacture a use for their waste material from the bricks and tiles. For that reason, in Europe, the brickyards have obtained the right to manufacture this chimney by buying the license.

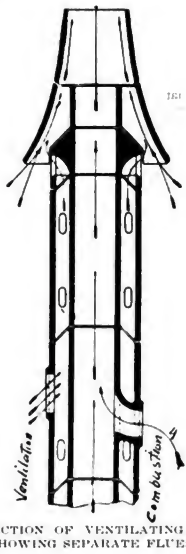


FIG. 1—SECTION OF VENTILATING CHIMNEY SHOWING SEPARATE FLUES.

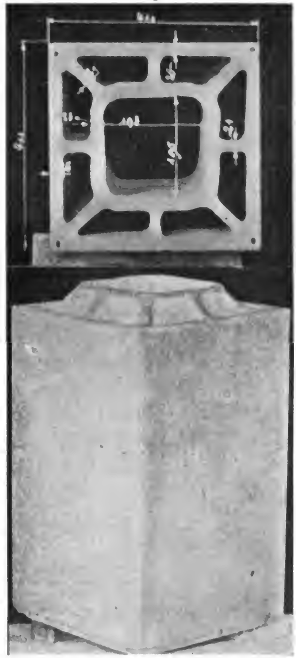


FIG. 2—A CHIMNEY BLOCK IN ELEVATION AND SECTION.

The principle involved in the new chimney is embodied in a smoke chimney with air-ducts, which are provided around it, and so arranged as to produced insulation. On the other hand these insulating air-ducts serve the purpose of ventilating the rooms in buildings. They are heated from the chimney walls, thus assisting the removal of the foul air. The new chimney is composed of a number of single sections, of about 3 ft. in length, which are simply put one on top of the other.

The manufacture of the chimney sections is very simple. Cement and crushed brick material are mixed in a mixer, one part to seven parts, with plenty of water. The loose concrete is then filled into the moulds, which are placed on portable shaking benches. When through the shaking movement the concrete has settled densely in the moulds,

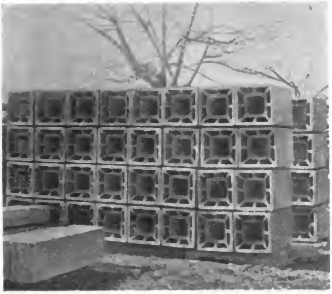


FIG. 3—A STACK OF FINISHED CONCRETE CHIMNEY UNITS.

these, being mounted on wheel cars, are pushed into a drying chamber. This chamber is advantageously heated by means of the waste heat from the boilers or kiln in the brickyard. Thereby the hardening of the concrete is accelerated, so that the chimney sections can be taken out of the moulds easily after the lapse of eight hours. Thus the manufacture is effected almost entirely automatically and by means of machines. The material being yielded from the waste of brick and tile making, it is evident that the chimney blocks can be produced very cheaply.

The manufacture of these chimney blocks is done in Europe in most cases in connection with a brickyard. The reason for this is that in consequence of many protracted trials and experiments, it has been found that concrete made from crushed bricks and cement furnish the most advantageous and suitable material for the manufacture of a chimney. The brick yards use for this concrete instead of gravel the waste gotten in making bricks and tiles, etc., which then is crushed to pieces averaging one inch and less. This material which already has been fired in a heat of about 1,000 degrees centigrade, is proof against any heat, while when mixed with cement it assimilates it by suction and becomes thereby extremely dense. This mixture has been termed "brandstein," which means "firestone." It does not undergo any changes, either through moisture or heat and developes an excellent strength, as has been proved by the different official testing laboratories in Germany. The tests were made to ascertain the safety against fire, density, and the compression strength.

Here are only some of the many advantages of this kind of chimney in comparison with brick chimneys. They are absolutely fireproof, as there are a few joints only, and the fire gases pass through the interior of the chimney made of concrete, and insulated by air ducts. One sketch shows the number of joints of a brick chimney in comparison with the Schofer chimney. No plastering of the chimney walls required either inside or outside, as both are quite smooth. No special ventilation of the dwelling rooms required, as the air-tight; and of the comfort of the ventilation

Erection is quick, as the chimney parts of 3 ft. length are simply put on each other. Two men can put together 100 ft. a day.

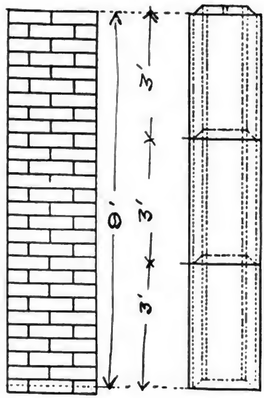


FIG. 4—COMPARISON OF NUMBER OF JOINTS IN A BRICK OR CONCRETE CHIMNEY.

The chimney weighs less than half of the ordinary flues and can be placed on beams. All the other advantages are in regard to the perfection of the draft, because the chimneys are absolutely air-tight; and of the comfort of the ventilation through the outside air-ducts, which cannot be explained here in detail.

In any event the combined ventilating chimney offers a new great field for use of cement. "Brick" concrete has not yet been developed to any great extent, but for this purpose it is adapted better than any other material.

Although this invention is hardly one year old, the patents are already sold in all the European countries and about twenty brick yards manufacture already the chimney stones in Europe.

CONCRETE RADIATORS AND MOIST AIR

A RECENT German invention is a concrete radiator for steam or hot water heat which was exhibited in different shapes and constructions last year at the Hygienic Exhibition in Dresden. It improves the sanitary condition of our living rooms by supplying together with the heat the moisture needed for the system of every human being who stays for lengths of time in a heated room.

The radiators are manufactured by pouring a mixture of cement and sand into special gypsum-moulds, or iron castings. They can be made in all colors and shapes. The thickness of the walls is about ⅜ in. The specific gravity of the concrete material is low and in consequence 10 sq. ft. of radiator space weigh only 20 kg., which is hardly more than half of the weight of iron radiators.

The advantages in a sanitary view is to prevent the formation of dry air in a heated room. The concrete radiators are porous, allowing moisture to go through. They heat more quickly and cool off more slowly than the iron radiator. They do not rust and can therefore be connected to hot-water heating. Notwithstanding these advantages the concrete radiator costs very much less than the iron radiator.

The tests made with this radiator in different testing laboratories proved the superiority of them over the iron radiators.

The difference between the two systems in regard to the effect of the relative moisture contents of the air in dwelling rooms can be seen by the following statement:

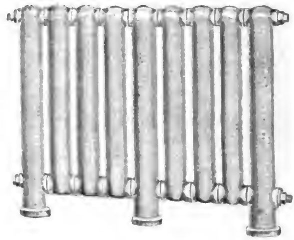
Concrete radiators alone:

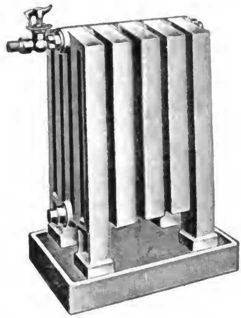
Time	Hours	Hygrometer
9:00	—	31.5
9:15	¼	36.2
9:30	½	36.7
10:00	1	37.7
10:30	1½	38.0
11:00	2	38.4
12:00	3	39.0
2:00	5½	40.0

Iron radiator in operation after the concrete radiator turned off.

Time	Hours	Hygrometer
2:30	—	40.0
3:00	6	39.0
3:30	6½	38.6
4:00	7	38.3
5:00	8	37.7
6:00	9	37.1
7:00	10	36.4
9:00	12	35.0

This proves that the moisture of the air increased by using the concrete radiator within 5½ hours from 35 per cent. to 40 per cent., while in the next 6¼ hours, when the iron radiator was in operation the moisture disappeared again and the hygrometer went down from 40 per cent. to 35 per cent.





TYPE OF CONCRETE RADIATORS DEVELOPED IN GERMANY.

As it is the endeavor to furnish for the comfort of habited rooms moist air, this purpose can be attained very easily by installing a concrete radiator in the room. With the application of iron radiators, however, the rooms always will dry, if no special devices for water evaporating are applied.

For that reason the concrete radiator improves the sanitary conditions of our dwelling houses

At the Exhibition in Dresden radiators were shown in all possible forms and colors, and it seems that in Europe, where still the tile-stove is much used, to prevent dry air in rooms, this radiator will find a wide distribution.

Tests made as to the influence of sodium phosphate solutions on concrete show that the concrete has a greater compressive and tensile strength than the concrete exposed to pure water. With increasing phosphate solution, the strength of the concrete increases. Similar results showed when concrete was exposed for three months to sodium borate solutions, except that the strengths were smaller.

AN ARTISTIC CONCRETE FOUNTAIN

By A. B. Collins

THE fountain illustrated herewith is located in the Hudson County Park, Jersey City, New Jersey. It was designed especially by Pierre J. Cheron, a New York City sculptor, and harmonizes entirely with its surroundings, making it a beautiful and dignified decorative feature from the main approach. It is probably the largest concrete monument ever attempted in this country, as it contains 365 tons of concrete and has a total height of 53 feet.

The main base of the fountain is 14 ft. high; the three shelves on the curve of the base each measure 8 ft. across, while the dolphines are 6 ft. long. The main bowl is 16 ft. in diameter, from the center of which runs the main shaft, of monolithic construction. It is fluted, measures 10½ ft. high and is in turn surmounted by an upper basin. The latter measures 8½ ft. in diameter and on top of it is another column 7 ft. and 4 in. in height. The eagle on top is 2½ ft. high, making the total height 53 ft. The fountain has 27 spouts, and is equipped with 150 electric lamps, which will make a brilliant illumination at night. There are also 24 large concrete vases an equal distance apart on the basin wall.

The modeling for the work was of course, done in the studios of the sculptor and in the shop of the Erkins Studios,† but all the molds and actual casting and construction was done on the job. The mixture used throughout was one of cement, two of sand, four of clean washed gravel.

The forms were allowed to remain in place until the entire fountain was constructed, thus giving the surface ample opportunity to harden before being exposed to quick drying by sun. This was especially important as the work was carried on during the hot months of June, July and August. No plastering or surfacing of any part of the fountain was done after the forms were removed, nothing but rubbing and tooling. In every case, the mixture was put in a fairly wet condition, so that water would flush to the surface when tamped, the gravel being worked back from the surfac and a two-to-one mixture of sand and cement tamped against the face of the molds. After finishing, the entire fountain was rubbed with carborundum stones and washed with an acid wash. The resulting effect is of more or less rough texture, with no slick or smooth spots.

The fountain is guaranteed against crazing, cracking or defects of any sort for a period of ten years. Absolutely no trouble is anticipated on this score, in view of the fact that molds were allowed to remain over the casting in every case for at least a week, and in view, also, of the fact, that the water was turned on immediately after the fountain was finished, and consequently kept the work wet constantly, so that the concrete had every opportunity to receive all the water which it was capable of absorbing

The use of concrete in such a structure is a wonderful example of the economical utility of this material in artistic execution.

A CONCRETE FOUNTAIN IN JERSEY CITY, N. J.
This fountain was built entirely of concrete, the structural features cast in place, and the ornamental detail pre-cast.

*New York.
†New York.

FIG. 1—CONCRETE FOUNTAIN IN CENTRAL PARK, LOS ANGELES.

CONCRETE FOUNTAIN IN LOS ANGELES

Concrete has been used very successfully in artistic fountain construction. One of the earliest fountains built in this country is that in Wade Park, Cleveland, Ohio. This was built almost thirty years ago, and is still in good condition.

The accompanying photographs and drawings show a fountain recently completed in Central Park, Los Angeles, by the Cement Products and Construction Co., of that city. The essential features of this fountain are indicated in the sectional drawing. The structure is one more example of the wonderful beauty and economic utility of concrete.

FIG. 2—DETAIL OF BASIN AND GROUP IN THE CONCRETE FOUNTAIN AT CENTRAL PARK, LOS ANGELES.

CONCRETE AND THE BRICKLAYERS

The particular reason why concrete men owe a debt of gratitude to the bricklayers is stated by M. C. Tuttle, secretary of the Aberthaw Construction Co., in a recent paper. He says:

"The cost of cement and the labor cost of building reinforced concrete are two items unique in our day, in that they have decreased in the last few years. The labor cost has gone down in the face of higher wages, because of greater skill in planning and executing work. If this cost continues to drop, and the price of lumber and the cost of brick work continue their present rise the two constructions will eventually exchange positions. The concrete industry has to thank the bricklayers and their decreasing output per man at higher wages for much of its advance."

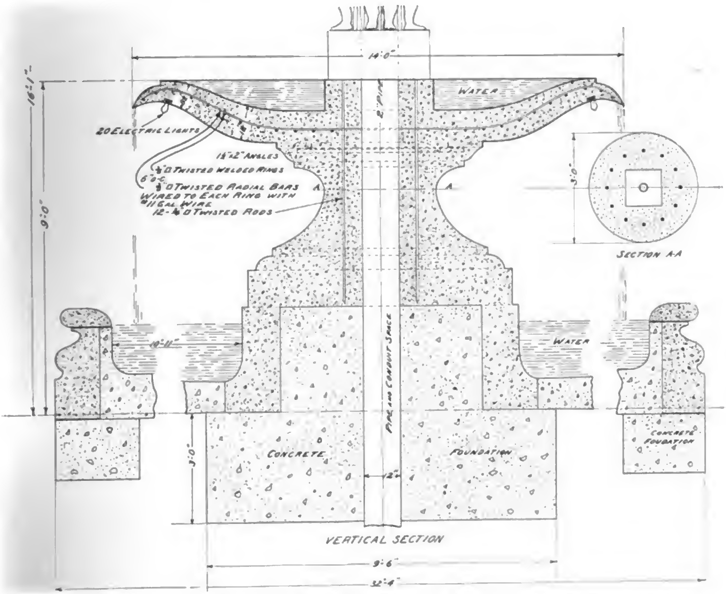


FIG. 3—SECTION OF CONCRETE FOUNTAIN AT LOS ANGELES, SHOWING DETAILS OF CONSTRUCTION.

COSTS OF TYING STEEL

THE comparative cost of the use of wire pliers or mechanical tyers has recently been arrived at on the Grand Central Terminal work, New York City. The cost data of W. F. Jordan, Ch. Eng., of the Grand Central Terminal Improvements of the New York Central & Hudson River R. R., shows very large reduction in labor cost in binding the intersection of reinforcing rods with a tyer* in comparison with the use of pliers and straight wire ties. This detail is as follows:

Cost of old method with pliers and straight wire ties—32 cents per 100 ties, including material.

Cost with Curry tyer when first used, before the men had sufficient practice to gain full speed—15 cents per 100 ties.

Approximate cost at present with full speed of operation—10 cents per 100 ties.

These costs are based on a labor wage of 17 cents to 20 cents per hour, and include the cost of the wire or the ties. The ties cost 5 cents per hundred.

Mr. Jordan further reports that the use of the Curry tyer gives absolutely accurate tying and prevents rods slipping. This is of course a great improvement. Also he states that there were many days in cold weather when men would not use pliers at all, but with a tyer he was able to keep up full speed under the most adverse weather conditions.

He further reports that he had no difficulty with the men on account of sore hands, which was a considerable handicap when pliers were used. They have not lost a single tool.

Therefore, the saving on their work by the use of this system is 22 cents per 100 ties, besides which they get better work, full speed under all conditions, and with the cheapest unskilled labor procurable. The accumulated saving at present to the New York Central & Hudson River R. R., based on these figures amounts to $3,876.40 on orders received to date and extending over a period of fifteen months.

*The "Curry" tyer, manufactured by the Clifford C. Miller Co., was used.

ARTISTIC CONCRETE COLUMNS

THE Columbia Osteopathic Hospital has just been completed at Los Angeles at a total cost of about $275,000. It is reinforced concrete throughout, the concrete walls being veneered with glazed brick. All the trim, sills, lintels, arches, pilasters, columns, capitals and bases are of concrete stone, made with a facing material of crushed granite and stainless white cement, giving a surface texture closely resembling cut granite.

The most striking feature of the building is the colonnade composed of four fluted massive columns in the Ionic order. These columns are 33 ft. in height and 4 ft. in diameter at the base of the shaft and were built of concrete stone in sections surrounding reinforced concrete columns 15 in. square. Attention is called to the membering of the flutes from each section to the one above it and to the delicate curve of the entasis and the details of the capitals. The capitals were each cast in four sections. Total weight of one column, capital and base is approximately 25 tons or a total for the four columns of 100 tons.

The original plan had been to veneer these columns with terra cotta, and the body of the columns was built up as a shaft of reinforced concrete, intended to be the supporting of load carrying core for the terra cotta ornamentation. Terra cotta, however, was abandoned for art concrete, in spite of the expressed doubts of many that it would be impossible to successfully build them in this manner with concrete and maintain a perfect entasis with the flutes in the different sections membering. The results obtained by the sub-contractors in this work proved, however, highly gratifying.

The usual method employed in erecting columns of concrete is to set the complete carved moulds in place and build the columns monolithically, the load being placed on the columns after time had been allowed for them to set and gain their strength. Since the core had been erected it was necessary to build the exterior and ornamental portion of the columns in sections and set these around the shafts, making the joints at each course. These sections were made as large as could be handled, weighing from 500 to 700 lbs. each. When the two halves of each section were set in place the space between them and the concrete core was filled with concrete. This is indicated in Fig. 3.

Columbia Hospital is probably the most thoroughly fireproof hospital building in the Southwest. The building stands on a beautifully terraced knoll, or land prominence, with five stories on the lower side and three stories on the upper side, presenting a very handsome and imposing sight from the streets below. Norman F. Marsh, of Los Angeles, was the architect.

We are indebted to G. Ivan Peoples, president of the Cement Products and Construction Co., of Los Angeles for these notes and illustrations. All the "Art Concrete" was made at their factory in Los Angeles.

Their plant consists of two acres of yard and a factory building 50 ft. x 200 ft., housing the drafting room on the second floor and power plant, modeler's shop, grinding rooms and a pattern shop on the first floor equipped with all

FIG. 1—ENTRANCE COLUMBIA OSTEOPATHIC HOSPITAL LOS ANGELES.
The entrance columns are of concrete as detailed in Figs. 2 and 3.

FIG. 2—DETAIL OF UPPER COLUMN, CAPITAL AND CORNICE, ALL OF PRE-CAST CONCRETE.

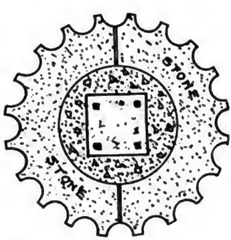


FIG. 3—SECTION OF COLUMN SHOWING REINFORCED CONCRETE CORE.

modern machinery adapted to the production of moulds and models. All casting is done by hand and the products protected from sun and wind until thoroughly cured.

"DAMPLESS" WALLS, A SUGGESTED FURRING

Solid concrete wall construction presents many structural advantages, and if the inner surface of the wall could be insulated to prevent condensation, we would have, no doubt, a nearly ideal wall.

In advocating concrete from a sanitary standpoint, we say that it is solid and all parts can be cleaned. A hollow wall, or a block wall, or a furred wall, is not solid; and although the concealed parts are so well sealed that cleaning is unnecessary, yet it is not solid. The recesses are there.

Another detail is to lay up inside of the wall a gypsum or clay tile. This, handled in small units, would not be economical; and I am now writing to ask if there is available a product about as follows:

MATERIAL: The structure should be scoriaceous, or spongy, like coarse cinders, or as we sometimes find spongy slag. It could be burnt clay, an asbestos cement compound or a gypsum product. The latter would be prepared, as it could be cut and shaped with hand tools, would be light, and easily handled.

DIMENSION: The thickness might be about 1 in. and the sheets could be 24 in. x 24 in. or larger.

PLACING: Endeavoring to nail it on would spoil the insulation by bringing metal to the surface. The ideal way would be to glue it on with a tar or bitumen size. This would make additional dampproofing, and make a good job.

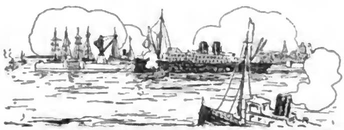
FINISH: A thin coat of hard plaster, smooth or rough cast would finish the wall, or perhaps the sheathing would be of such finish that it could be tinted direct, using a rosette or button at the corners.

The cellular structure of bread is developed by expansion of gas freed in fermentation. Would it not be possible to add to a plastic compound, an ingredient which would free a gas, and produce, in setting, a cellular structure.

Such a material, used to line a comparatively thin, monolithic concrete wall, should make for better and lower cost structures.

Moving Pictures of Concrete Roads

The Universal Portland Cement Co. has taken motion picture films of the concrete roads in Wayne County, Michigan, contrasting unimproved roads with roads that have been improved with concrete. The films also show the complete process of construction. Motion pictures have also been taken of concrete road work in other parts of the country which will be used by the company in its campaign for the building of concrete roads. Wherever good roads meetings are held or wherever any street or road improvement proposition is under consideration, the Universal Company is prepared to make a display of its motion picture films to prove the serviceability and economy of paving with concrete.



FOREIGN NOTES

Fire in Reinforced Concrete Building

On May 30, a reinforced concrete apartment house in course of construction in the city of Hamburg was set on fire by a blaze which started in a smithy in the contractor's plant near the building. At the time the building was practically completed as regards the skeleton framework, and all the floors were covered with falsework, which gave ready fuel to the flames, and was entirely consumed. The reinforced concrete, although green, was not injured to a great extent, showing the fireproof qualities of concrete. How severe the blaze was may be seen from the fact that during the first half hour the excessive heat prevented any close approach to fight the flames. The roof over the top story was only three days old, and, although the entire falsework and wooden props were consumed, it did not collapse. The explanation may be found in the assumption that the heat caused a very rapid setting of concrete, which is also borne out by the looks of the same. The strength of the concrete was, however, seriously impaired by the rapid setting, so that small pieces which had fallen, crumbled in the hand at touch. This part of the building will have to be renewed. The floors of the other seven stories, which had been ten days in the falsework at the time of the fire were found to be practically intact and will not need rebuilding. The lesson drawn from this incident is the extreme care necessary in reinforced concrete construction, where large quantities of wood are used for the falsework, and in this connection the rules provided by the Vienna building department may not be out of place.

In reinforced concrete construction the following rules must be observed:

1. Only electric light may be used for artificial lighting, as long as there is any falsework in the building.
2. If concrete mixers are driven by gasoline or benzine engines, they must be placed at some distance from the building in an easily accessible place.
3. The necessary supply of benzine must not exceed one day's supply and must be stored in fireproof, explosion proof tanks.
4. The wood waste from the falsework must be collected each day by workmen, detailed for this work and removed from the building.
5. Forges or smithies must not be set up anywhere within the building.
6. All workmen must be instructed where the nearest fire alarm box is to be found, and how to send in an alarm in case of a fire.—*Armierter Beton.*

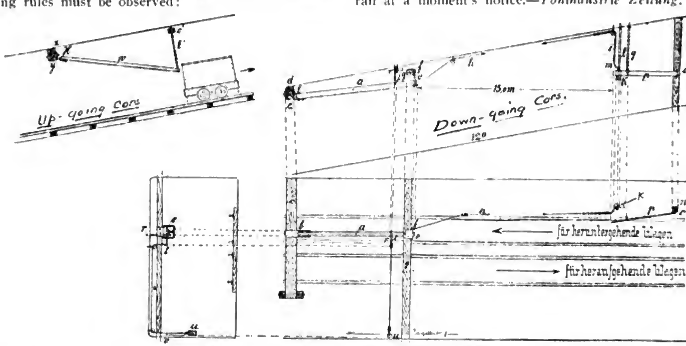
Safety Catch for Runaway Cars

In many Portland cement plants inclined industrial railways, operated by wire rope are used, and the safety catch illustrated in the figure is of interest.

1. Ascending Cars: Rail *w* is suspended by means of hinge *x* from the beams *x*, *y*, and *z*, which are firmly attached to the roof of the building or of the mine, as the case may be. The other end of rail *w* is held by chain *l*, attached to beam *c* at such a height, that the end of the rail is slightly below the upper edge of the industrial cars. Ascending cars brush by this rail and pass it. Descending cars are stopped by it.

2. Descending Cars: The iron bar *p*, fitted in hinge *o*, the latter attached to the roof of the building or mine, is suspended by means of chain *q* diagonally across the rails, and is brushed aside by the cars passing it in regular order.

If a car rushes past at too great a speed due to a break in the rope or other causes, the iron bar *p* is struck back so forcibly, that it releases a weight *k*, which is suspended from a long bar *l*. Weight *k* falls, and withdraws by means of chain *m*, *i*, *h*, a stirrup *e* from beneath the rail *a*, so that the rail *a* falls and obstructs the track, *f* and *g* are the suspension devices for *e*; *b*, *c*, *d* those for *a*. A weight *u*, and a lever *t*, rotating from bolt *r*, as also a rope transmission system *s* help to drop the rail at a moment's notice.—*Toninindustrie Zeitung.*



SAFETY CATCH FOR RUNAWAY CARS.

DIRECT OR INDIRECT TESTING OF CONCRETE, THE USE OF FLEXURE TESTS

The direct testing of concrete cubes in hydraulic presses has various disadvantages aside from the great expense of such testing machines and the cost of transportation which is considerable where large numbers of test cubes have to be sent from the building under construction to the testing laboratory. Testing these concrete cubes is to bring out the qualities of the concrete as used in the building and not the uniformity of results, and the cubes should be made in exactly the same manner as the beams and structural parts used in the building. That this is very difficult to accomplish when making concrete cubes for laboratory use is evident.

As members in bending are subjected to tensile and compressive stresses, the load which a beam can sustain is an indication of the compressive or tensile strength of that member. The bending test is therefore nothing but an indirect tensile or compressive test. The success of Dr. von Emperger's control beam* has proved this assertion.

The firm of Buchheim & Heister at Frankfort-on-Main, Germany, have evidently solved the question in their new control beam machine. They call the new system the "reform beam," and the weight of the beam is such that it can be transported with ease by one man. The "reform beam" serves as an excellent illustration for an explanation of the effect of the "control beam." As the tensile strength of concrete is so much less than the compressive strength, a simple concrete beam tested in bending, indicates only the tensile strength. If steel reinforcement is properly placed in the tensile zone, a load will result in the destruction of the concrete in compression.

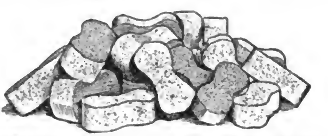
FIG. 1—SPECIMENS AND THE CASING REQUIRED FOR BUILDING TESTS OF SMALL BEAMS.

*Described in "Cement Age," November, 1911; March, 1912.

FIG. 2—SMALL BEAMS WHICH HAVE BEEN TESTED FOR BOTH COMPRESSION AND TENSION.

In the small test beam the reinforcement consists of a 10 cm. (4 in.) wide and 0.5 cm. (0.2 in.) thick band iron, bent at both ends to a semi-circular shape. The bond with the concrete is further safeguarded by the use of autogenous welded stirrup like flat steel bars. To complete the concrete beam, only two 12 cm. (4.8 in.) wide boards are needed, which are placed against the sides of the band iron, and held there by clamps. Fig. 1 shows such a mould and two beams ready for testing. The band iron enables moving of the beam after one or two days' setting. The new beam in cross-section is 10 cm. (4 in.) wide, and 11.75 cm. (4.7 in.) in effective height. The length has been set at 1 m. (3.3 ft.), giving therefore a very light beam of 28 to 30 kg. weight (61 to 66 lb.) This can be carried by one man.

The testing machine, which is used to test these beams is to be described in a later issue. An added advantage to these beams is the fact that the concrete can be tested for tension as well as for compression. To test for tensile strength, the beam is placed in the testing machine wrong side up, so that the non-reinforced concrete forms the tensile zone. Slowly the moment of force increases until a slight crack in the surface of the beam shows the breaking, and the machine is stopped. The strength of the strap of steel prevents the displacement of the two portions of the beam after the break. If the beam is now turned, the same can be tested by compression. Fig. 2 shows on the right a beam in which the crack has just appeared, and on the left two beams tested for compression. —*Beton nd Eisen.*



BRIQUETTES

MONTHLY COMPARATIVE TABLE

Imports of Portland, Roman and Hydraulic Cements.

Country	Month of Feb., 1911 Barrels	Month of Feb., 1911 Value	Month of Feb., 1912 Barrels	Month of Feb., 1912 Value
United Kingdom	84	$ 137	84	$ 145
Belgium	111	105	......	......
Germany	5,924	9,449	3,613	4,427
Canada	......	......	......	......
Other Countries	163	382	283	440
	6,282	$10,073	3,980	$5,012
Less Foreign Cement Exported	721	1,213	57	89
	5,561	$ 8,860	3,923	$4,923

Decrease in imports during the month of Feb., 1912, as compared with Feb., 1911 . . . . . . 1,638 barrels

Country	8 Months Ending February, 1911 Barrels	8 Months Ending February, 1911 Value	8 Months Ending February, 1912 Barrels	8 Months Ending February, 1912 Value
United Kingdom	21,667	$ 24,567	24,745	$30,071
Belgium	71,960	89,898	5,147	5,935
Germany	42,978	60,889	55,515	88,843
Canada	379	963	71	145
Other Countries	13,697	19,640	8,424	13,043
	150,681	195,957	93,902	138,037
Less Foreign Cement Exported	14,994	19,015	3,083	5,898
	135,687	176,942	90,819	132,139

Decrease in imports during 8 mos. ending Feb., 1912 over 8 mos. ending Feb., 1911 . . . . 44,868 barrels.

Imports of Portland Cement into the U. S. during February, 1912 by Districts

District	Barrels	Value
New York	1,056	$ 1,295
Porto Rico	284	440
New Orleans...	186	321
Hawaii........	2,326	2,735
Louisville......	128	221
	3,980	$ 5,012

Exports of Cement

Exports of cement, month of Feb., 1911—198,552 bbls., value $291,730
Exports of cement, month of Feb., 1912—263,761 bbls., value $376,093
Increase in exports, month of Feb., 1912, over month of Feb. 1911 . . . . 65,209 barrels
Exports of cement, 8 mos. ending Feb., 1911, 1,880,976 bbls., value $2,730,164
Exports of cement, 8 mos. ending Feb., 1912 2,021,574 bbls., value $2,980,965
Increase in exports during 8 mos. ending Feb., 1912 over 8 mos. ending Feb., 1911 . . . 140,598 barrels

CEMENT PRODUCTION, IMPORTS AND EXPORTS

Cement production, consumption, and exportation are showing remarkable increases in the statistical records of the United States, as shown by figures of the Bureau of Statistics, Department of Commerce and Labor, while the importation shows an equally remarkable decline. The quantity produced, according to figures of the Bureau of Statistics presented in its Statistical Abstract, just issued, has grown from 8 million bbls. in 1890 to 17 million in 1900 and 78 million in 1910, the value having increased from 6 million dollars in 1890 to 13 million in 1900 and 69 million in 1910. Meantime the figures of imports and exports show equally striking changes. The quantity of cement exported has grown from 76,055 bbls. (of 380 lbs.) in 1900, valued at $163,162, to 2,971,474 bbls. in 1911, valued at $4,349,290; while the figures for the 9 months ending with March indicate that the total for the fiscal year 1912 will considerably exceed, in both quantity and value, that of 1911 and will probably amount to more than 3 million bbls., or 40 times as much in 1912 as in 1900, with a value of more than 5 million dollars, as against $163,162 in 1900.

The United States is apparently leading the world in the production of cement for industrial purposes. The latest figures available in the Bureau of Statistics with reference to production in various parts of the world places the production in Germany at about 30 million bbls., or considerably less than half that of the United States, and that of England, slightly less than 20 million bbls. Of the 78 million bbls. produced in the United States in 1910 a very large proportion is consumed at home, the exports for that year being but about 2½ million bbls.

Pennsylvania is by far the largest producer of cement, about one-third of the 78 million barrels produced in 1910 being the product of that State, the States following next in order of production being Indiana, Kansas, Illinois, Missouri, New Jersey, Michigan and New York.

The cement industry, according to the census of 1910, showed number of establishments, 135; capital invested, $187,398,000; number of wage earners, 26,775; wages paid, $15,320,000; cost of materials, $29,344,000; value of products, $63,205,000; value added by manufacture (value of products less cost of materials) $33,861,000.

Panama now takes over 65 per cent. of the cement exported from the United States, the total exported thereto in the fiscal year 1911 having been nearly 2 million bbls. out of a total of 3 million, while various countries of North and South America took most of the remainder. Cuba was credited with 429,000 bbls., Mexico, 194,000; and Canada, 153,000. Other countries, some 35 in number, appear in the list of destinations, but in no case did the total in 1911 amount to as much as 50,000 barrels.

Danish New Standard Tests for Cement

The first specification relating to tests for Portland cement was published in 1878, and continued in force until March, 1911. The Danish Government then adopted a standard similar to that prevailing in Germany up to the end of 1909. One noteworthy feature of the new regulations is that compressive resistance is regarded as more important than tensile resistance, the latter being ascertained merely for the purpose of comparison.

FOREIGN CEMENT PROJECT

Readers of the Annual Manufacturers' Number missed the usual interesting letter from H. W. Anderson, of England, summarizing the cement industry in that country. This was due to the fact that Mr. Anderson is in Bombay, India, from which place he writes that he will be occupied with various works for some time. Having previously been in New Zealand and America, Mr. Anderson has not been in close touch with affairs in England, but notes as a matter of special interest the report of a still larger combine of British manufacturers than that originally formed in 1900.

He states that the Associated Portland Cement Manufacturers have started on their new works in Vancouver, B. C., and other projects abroad may follow if they retain their trade of former standing in various markets.

There is also a project afoot in Tasmania for cement and in New Zealand makers are contemplating enlargements. In British India the Madras works have been electrified and plans prepared for enlarging the plant, while no less than three projects for works in Northern India will be shortly placed. before the public.

Concerning the enlarged British combine to which Mr. Anderson refers, the following clipping from the London *Times* is interesting:

"It is stated that Lord St. Davids will be the chairman of the company, which will have an issued capital of £3,500,000, guaranteed by a number of leading London banking and financial houses. No public issue of stocks or shares or circulation of prospectuses will be made.

"The new concern will control an output of about 1,500,000 tons of cement annually. The price to be paid for the local companies, it is said, exceeds £185,000. The new company will have a working agreement with the Associated Cement Company, of which Lord St. Davids is also chairman, and the capital of both companies will amount to about £12,000,000. The two companies will control five-sixths of the cement production in the country. A. C. Davis, managing director of the Saxon and Norman Companies, will be managing director of the new company."

Clay Interests "Invest" in Cement Tile Machine Rights

In the April issue of CEMENT AGE it was announced that the clay interests had bought the Thomas glazed cement sewer pipe machine rights in the State of Washington. It now develops that the Clay interests have also bought the unoccupied territory of both Washington and Oregon, and further, they have purchased the operating plant at Tacoma and have dismantled it. They are also endeavoring to buy the Portland Glazed Cement Pipe Company, of Portland, Ore., which they will undoubtedly dismantle if they succeed in purchasing it.

Recent information comes from Will A. Cutliss, 801 Lowman Building, Seattle, who is associated with the Thomas Company, and from his letter to C. W. Boynton of the Universal Portland Cement Co., the following is quoted:

"We received patents to the Thomas Machine less than three years ago and have built and put into operation twenty-eight machines. We make a pipe with bell and spigot end that will stand any test against vitrified clay. In our fight with the clay people we have had seventeen city governments change their ordinance, allowing glazed cement pipe on all city work in competition with clay. During 1911 we put in the ground over two million feet of glazed cement pipe for sewer purposes, sizes ranging from 3 in. to 30 in. in diametet. Our plants used over seven hundred cars of cement, and this year we have doubled the capacity of three plants, put in four new machines, and will use over one thousand cars of cement."

The clay people of the Northwest undoubtedly consider the Thomas machine a formidable competitor, otherwise they could hardly be persuaded to buy up this territory.

Carload Lots of Cement

To handle cement most efficiently and co-operate with the railroads in getting the most use out of their rolling stock, cement should be ordered so that the boxcar used develops its full capacity. Cars are built with the following capacities: 40,000, 50,000, 60,000, 80,0000 and 100,000 lbs. Of these the sizes above 50,000 lbs. are more common.

To use the cars to the best advantage, cement should be ordered where possible, in the following units:

Unit Order (maximum for car)	Marked Capacity of Car
115 bbls.	40,000 lbs.
140 bbls.	50,000 lbs.
170 bbls.	60,000 lbs.
230 bbls.	80,000 lbs.
280 bbls.	100,000 lbs.

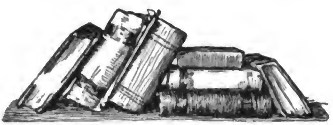
Railroad tariffs in different territories provide different minimum weights for carload shipments of cement, ranging from 38,000 to 50,000 lbs. and in the case of certain short hauls, the minimum is 60,000 lbs.

Duty on Cement Should Be Reduced

The Winnipeg Board of Trade has recommended that the Canadian import duty on cement be reduced or abolished. The rates of duty at present on cement are: British preferential, 8 cents per 100 pounds; intermediate, 11 cents per 100 pounds; general, 12½ cents per 100 pounds. It is claimed that these rates are too high, and only serve to swell the profits of the combination of cement manufacturers in Canada.

Cars for Cement

An order for 100 steel cars for use by the Steel Corporation's roads in the cement trade, have been ordered by the Pittsburgh, Bessemer and Lake Erie Railroad. This order was part of a contract calling for 2,000 cars recently placed. The cars will be of 100,000 lbs. capacity. These cars will be the first built exclusively for cement hauling.



RECENT PUBLICATIONS

THE TWELVE PRINCIPLES OF EFFICIENCY, by Harrington Emerson. Published by the Engineering Magazine, 140 Nassau St., New York. 5x7½ ins., cloth bound, 448 pages. Price $2.00.

REINFORCED CONCRETE DESIGN by Oscar Faber and P. G. Bowie. Published by Longman, Green & Co., New York. 5½x8½ ins., cloth bound, 332 pages. Illustrated. Price $3.50 net.

BUILDING STONES AND CLAYS. By Edwin C. Eckel, C.E. Published by John Wiley & Sons, 43 East Nineteenth street, New York. 6 by 9 in.; cloth bound; 264 pages; illustrated. Price, $30.00.

CONSTRUCTING CONCRETE PORCHES, by A. A. Houghton. Published by the Norman W. Henly Pub. Co., New York City. 5x7 ins., paper bound, 62 pages. Illustrated. Price 50 cents.

CONCRETE BRIDGES CULVERTS AND SEWERS, by A. A. Houghton. Published by the Norman W. Henly Pub. Co., New York City. 5x7 ins., paper bound, 58 pages. Illustrated. Price 50 cents.

SUBURBAN NEW YORK. Published by *The Globe*, 73 Dey st., New York. 10 x 13 inches, paper bound, 126 pages. Illustrated. Price 25 cents.

VERTICAL LIFT BRIDGES, THE EVOLUTION OF, by Henry Grattan Tyrrell, C. E. Published by the University of Toronto Engineering Society, Toronto, 1912. 6 x 9 inches, paper bound, 16 pages. 1 illustration.

MECHANICAL STRESSES IN TRANSMISSION LINES, University of Illinois Bulletin, by A. Guell. Published by the University, Urbana, Ill. 6x9 ins., paper bound, 31 pages. Illustrated. Price 25 cents.

HIGHWAY BRIDGES AND CULVERTS, by Charles H. Hoyt and William H. Burr. Published by Government Printing Office, Washington, D. C. 6x9 ins., paper bound 21 pages. Illustrated.

WEST VIRGINIA GEOLOGIAL SURVEY. I. C. White, State Geologist. Issued by the West Virginia Geological Survey, Morgantown, W. Va. 6 by 9 in.; 387 pages, plus XIV; cloth bound; 36 plates and illustrations and a case of three maps (topographic, geologic and soil). Price, $2.00. Extra copies of topographic or geologic map 50 cts.

AMERICAN SOCIETY OF ENGINEER DRAFTSMEN, YEAR BOOK, 116 Nassau St., New York City. 6x9 ins., paper bound, 16 pages.

TESTS OF COLUMNS: An Investigation of the Value of Concrete as Reinforcement for Structural Steel Columns. University of Illinois Bulletin, by A. N. Talbot and A. R. Lord. Published by the University, Urbana, Ill. 6x9 ins., paper bound, 44 pages. Illustrated. Price 25 cents.

This bulletin gives an account of the investigation of the strength of a type of column which has been used recently in the construction of reinforced concrete buildings. Structural steel angles are tied together by bent plates, making a form known as the Gray column, and this steel structure is itself filled with concrete and covered with a shell of concrete for fire-proofing purposes. Such a column requires less space than the ordinary reinforced concrete column. Whether in such a column the steel and the concrete act together to give a strong stiff column has been a matter of some doubt. In the investigation described, tests were made on unconcreted steel columns of various lengths to determine the strength of the steel columns and the effect of length upon strength. Tests were then made on similar columns filled with concrete. This enabled the action of the steel and of the concrete to be compared. The breaking loads were determined and the shortening of the concrete and of the steel was carefully measured. Tests were also made upon columns having a fireproofing shell and upon columns reinforced with spiral hooping. It was found that the column strength is approximately equal to the ultimate strength of the steel column of the same length plus the strength of a short concrete column of the same quality of concrete. For loads approaching the ultimate, the shell of fireproofing concrete clung to the column without spalling. The columns tested possessed the qualities of a good structural member and seem adapted to more general use in building construction.

A waterproof Portland cement has been tested at the Dresden technical school having the composition 1 pt. cement, 2½ pts. sand, 0.8 per cent "Preolite" mortar. Tested under water at 4 At. pressure no water penetrated the concrete.

Bending Moments Relative to End Fixity

A meeting of the Concrete Institute took place at Denison House, London, on April 11th last. Sir Henry Tanner, Pres. Concrete Inst. presided, and a paper by Maurice Behar, C. E. (Ecole des Ponts et Chaussees) M. C. I., entitled "The True Bending Moments of Beams with Various Degrees of Fixity" was submitted.

The object of this paper was to draw the attention of all those concerned with reinforced concrete to the disadvantages which would result from the application of certain theories and formulae. Special attention was devoted to consideration of the various degrees of fixity of the beams, and examples were set forth in order to establish a comparison from an economical point of view and also from the point of view of safety between the various cases mentioned. Calculations concerning the verification of the strength and stability of beams, slabs and pillars were given by the author and special attention was given also to the question of ascertaining the position of the neutral axis in various cases. The paper was mostly of a mathematical character, and had for its principal object the eliciting of views of all those concerned in the design of reinforced concrete in a discussion upon all the subjects dealt with in the paper.

The American Society for Testing Materials

At the recent meeting of this society the committee on cement submitted a revision of the report made to the Amer. Soc. of Civ. Eng. in January. As previously noted in CEMENT AGE a board has been established by several governmental departments to draw up a cement specification for U. S. Government use. Meetings have been held with that board in the endeavor to reach identical specifications and substantial agreement had been secured. The points of difference are the test for normal consistency (where the Department Board prefers the ball test) and the test for set (where the Board uses the Gilmore needles instead of the Vicat needle.)

Summer School at the University of Wisconsin

Announcement is made of the twelfth annual six weeks summer school of the College of Engineering of the University of Wisconsin, which opens on the twenty-fourth of June.

Courses of instruction and laboratory practice are offered in Electrical, Hydraulic, Steam and Gas Engineering, Mechanical Drawing, Applied Mechanics, Testing of Materials, Machine Design, Shopwork and Surveying, in addition to which subjects may be taken in the College of Letters and Science. For further information address F. E. Turneaure, University of Wisconsin, Madison, Wis.

FIRE-LESS SAYINGS

(By Thomas Fellows, Los Angeles, California)

We have fireless cookers, let us have fireless constructors.

A fireless constructor is one who so designs and builds that fires are impossible in his buildings.

Have your State make uniform building laws. Co-operate with towns and cities to secure their enforcement.

Concrete *can* be made to look *cheerful* and not depressing. Chose warm toned aggregates that give natural soft texture tones. Plan and build for the coming years beautiful structures.

We need more preventatives and not curative methods of fire fighting. Train fire departments so that the men can become experts in fire prevention. Furnish them text books, models, lectures, etc., etc., to utilize in their loafing time and thus absorb useful knowledge.

Set the State University at work. Let our would-be engineers write these on fire prevention.

Erect one model low-priced, fire-proof residence, store and schoolhouse in every city. Then urge the architects to design beautiful fire-proof, low-priced buildings.

Stone-Surfaced Floors

There is some prejudice to be overcome in the introduction of the cement finished floor for residences. The idea quite natural at first does not appeal, such floors having been hitherto cold and unattractive, but with tile in-lays and with the excellent cement coatings, which are now obtainable, however, such objections are being removed and cement flooring has been adopted successfully throughout our modern hotels, office buildings and apartments. Fireproof floor surfaces have been used abroad for many years, and the modern home must have a fire proof flooring, if it is to afford the maximum of protection from fire loss.

The "Cement Gun" at Panama

[Announcement of Isthmian Canal Commission, supplementing article in Daily Consular and Trade Reports for Sept. 8, 1911, on "Use of Cement Gun by the Government."]

The coating of cement mortar applied by the pneumatic cement gun which was sent to the Isthmus a little less than a year ago for use in spraying the surface of certain rock face in Culebra Cut, which disintegrated on exposure to air, was found not to prevent this disintegration. The concrete mixture sprayed on the smooth surface adhered uniformly, but was not sufficiently air-tight to retard appreciably the progress of disintegration. The gun was used recently on the relocated line of the Panama Railroad, in coating the surfaces of hand-laid revetment wall, made of hard Bas Obispo rock. In this case the concrete penetrated the interstices between the rocks as far as several feet and thus obtained a firm hold. Using a mixture of 1 part of cement to 3 of sand for the inner coating and 1 part of cement to 2 of sand for the final surfaces it was practicable to lay a smooth, strong coat from 2 to 3 ins. thick over an area of about 25 ft. square a day. The spraying was continuous. By the time the work had been carried from one end of the area under treatment to the other the first part was ready for another coat. In all, about 10,000 sq. ft. of revetment was treated.

The Sand-Blending Plant at the Arrowrock Dam Idaho

The Reclamation Service is preparing to install a plant for the blending of sand and cement at Arrowrock, Idaho. This plant will have a daily output of 100 bbl. of 40 per cent. blend sand cement, and will cost approximately $40,000. The product will be utilized in the construction of the Arrowrock dam, which is to be the highest masonry dam in the world. This enormous structure, which will be 351 ft. in height, will require 500,000 bbl. of cement, and the engineers estimate that the use of the blended sand and cement will effect a saving of more than $250,000 in the cost of the dam.

The Reclamation Service reports that experiments in the dilution of cement with extremely fine ground silica, notably on the Los Angeles aqueduct, have shown that great economy can be effected in concrete construction. On the aqueduct work the cement is being reground with volcanic rock, the latter comprising from 60 to 70 per cent. of the whole. This mixture is being used in the usual way in making concrete and is reported to be standing all the tests as to strength and other qualities. At the Arrowrock site there is an abundance of granite which, it is believed, will make a first-class blending material, and result in great saving in the cost of cement.

A Correction

On page 153 of the March issue, under the discussion of "The Strength of Flat Plates," by Tandy A. Bryson, "(b) or $(b)^n$" should have read "$\left(\frac{b}{a}\right)^1$ or $\left(\frac{b}{a}\right)^n$". We regret this typographical error.

PRACTICAL ADVANTAGES OF REINFORCED CONCRETE FOR TEXTILE MILL CONSTRUCTION

In textile manufacturing the advance in the use of concrete has been slower than in other lines of manufacturing. Throughout the whole country warehouses, factory buildings and office buildings have been erected entirely in reinforced concrete. There are now about 15 mills in this country built entirely in reinforced concrete and these are for the manufacture of cotton, woolen and knit goods. The writer has communicated with most of these mills, putting a few pointed questions, such as, "would you build again in concrete" and the answer in all cases was in the affirmative. This is apparently conclusive that we are far beyond the experimental stage and that the textile manufacturers are now seeing the advantage of this type of construction; and in the following paragraphs are detailed some of the reasons for this.

Insurance Maintenance: A most important reason is the fact that the cost of fire insurance on the buildings can be considerably reduced, as the fire insurance companies are now appreciating the fireproof qualities of concrete for housing the ever increasing value of machinery and stock in progress. The contents, however, must be protected even in fireproof mills by sprinklers and the regular fire protection system. The lower rate of insurance may not seem large enough to warrant erecting a concrete building, but everything saved in maintenance can be applied to the dividend power of the mill.

A concrete building erected adjacent to existing building reduces the cost of insurance for the whole plant, and can readily be veneered with brick on outside to conform to present buildings.

Rigidity: The subject of waste and greater production of goods is the constant study of the manufacturer. The management of all texile mills is ambitious to decrease the waste both of stock and mechanical equipment, and to increase the production of goods. This can be accomplished both ways with a greater steadiness in the running of machinery and power. This is possible as can readily be perceived from the fact that with rigid and level floors the machinery will run more steadily than if set upon plank floors and deflected wood beams.

The writer, when inspecting some English cotton mills, visited a saw-tooth weave shed with looms standing on flag stone. Being struck with the high speed of the looms they were at once counted and found them running 224 picks per minute. These were 36-in. and 40-in. looms. It is often asked how the English can make such good yarn out of poorer cotton than in America. Is the question not partly answered when it is understood that all their mills are fireproof, some with concrete floors and granolithic Portland cement top and some have smooth flag stone laid on brick arches?

A small weave room in this country was moved from a mill constructed building with plank floors into a concrete building and the manager was able to increase the speed of the looms to a much higher figure than was ever possible under the old conditions.

Lighting Efficiency: The great increase in window area for the admission of daylight making it particularly adaptable to wide mills becomes possible as the concrete pilasters, forming the exterior walls, are designed as columns.

The square-head windows which run up so high that they form a part of the floor slab, make possible a high light. Concrete mill structures, 125 ft. wide, would be better lighted than brick mills 100 ft. wide.

The Rapidity of Construction: This gives the use of reinforced concrete a high financial value in completing the building earlier than any other type of construction. There is no delay contingent upon slow delivery of materials, such as hard pine timbers, which on large orders of 16-in. timbers **are in the tree when ordered.** We learned of a plant recently where the roofs were delayed 30 days waiting for rafters.

When working with concrete it is a common thing after the foundations are completed to run up a story every ten working days using the same concrete forms over and over as the structure rises on the foundations. Work can be commenced promptly; cement, sand, broken stone, form lumber and steel bars are shipped straight, in most cases, and then bent to the desired shape at the building. It usually takes six months to build an average sized 4-story mill and have it ready for the machinery. A mill in concrete can be built and made ready for the machinery in five months. As an example, a factory in Brooklyn, N. Y., was built in just four months. This factory was very similar to mill construction. The size of this building was 75 ft. by 600 ft. and six stories high.

Temperature and Humidity: Concrete possesses heat-resisting qualities, which make interiors cooler in summer and lend to results desired for humidifying. This feature will assist the textile manufacturer in keeping the humidity in some the departments where it is most desired and also in keeping the building cooler in summer to reduce the temperature of high speed machinery and electric motors and to eliminate as much electricity from the atmosphere as possible.

Sanitary, Vermin-proof and Waterproof Floors: There is no question but what concrete floors are more sanitary than any other type of construction commonly used in textile mills. Granolithic floors, when properly treated, will not dust. The writer had opportunity to investigate and found proofs which will show that the question of raising dust is only a poor argument against the use of concrete.

Power Saved: Some readers will say that this is a time-worn subject, but the cost of fuel is increasing each year and must be kept in mind. In the weaving department, as an example, consider the comparison of a loom "dancing" on common mill floor plank and one standing on a rigid level concrete floor. The slip in the belt will be greater down to the loom which stands on plank than one which stands on the rigid floor. The slip will be increased as the floor beams supporting the shafting above deflect under the weight of the floor above. Until beams get their permanent set it involves the expense of shortening all slipping belts which cost time and loss of product.

We have not touched upon the well known fire resisting features of concrete, nor the fact that the maintenance is practically eliminated. Reinforced concrete for textile mill construction is rapidly becoming the recognized type.

SOME REFRACTORY SUBSTITUTES FOR WOOD

At the meeting held in Boston, November 16, 1911, the Boston Society of Civil Engineers, and the Boston section of the American Institute of Electrical Engineers co-operating, a paper was presented by Prof. Charles L. Norton, Mem. Am. Soc. M. E., of the Massachusetts Institute of Technology, on Some Refractory Substitutes for Wood, and the following from the Journal of the Assoc. Engineering Societies is an abstract:

The common use of wood in and around our buildings is responsible for a considerable part of the annual fire loss, and a satisfactory substitute has been long sought. A new material must approximate in lightness, strength, elasticity and ease of working, the natural woods, and further, since the variation in natural woods fits them for special details of construction, the substitute must be had in different grades of hardness, toughness, fineness of texture, etc

Many of the earlier attempts were made in the direction of altering the natural wood by some chemical treatment, so as to make it ignite with greater difficulty and burn more slowly and without much flame. The principle underlying the chemical treatment was usually one of two. First, the wood was saturated with a solution which, on drying, left in the pores a salt capable of giving off a gas when heated, this gas being of such a nature as to be incapable of supporting combustion. Phosphate of ammonia and tungstate of soda were extensively used for this purpose. The second method of chemical treatment was one in which such substances as alum were used in order to supply a considerable quantity of steam from the water of crystallization and also to encase the pores of cells with a solid refractory substance.

There have been from time to time, in the last 30 years, attempts to make use of the boards composed only of refractory, inorganic substances. In general, such boards have been composed of some fiber and a cementing medium. The most popular fibers for this sort of experimentation have been asbestos and mineral wool, the cements used including about all the common cements of both the air drying and the hydraulic types. Oxychloride of magnesium, the value of which as a cement was discovered some fifty years ago by Sorel, has been the favorite cement for experimenters because of its simple preparation, its quick hardening and great strength. For some reason, however, a large percentage of the oxychloride cement is variable in its properties and often defective. When mixed with sand or similar dense bodies the oxychloride is often satisfactory for long periods, but the experience of the author with mixtures of this cement with fibers, both organic and inorganic, leads to the conclusion that it is unstable and unsatisfactory. This is more probably the case when the boards are used in damp places or out of doors.

There next appeared a number of wood substitutes in which a fiber was bonded by silicate of soda, commonly known as water-glass. Some were made in this country, but the most serious attempts were made in England and Russia, where the Imshenetzky process was used to make a board called uralite. It was the most satisfactory substitute for wood which had appeared up to that time. Uralite was composed of a sheet of asbestos millboard saturated with a solution of silicate of soda, which was subsequently precipitated as colloidal silica by a solution of bicarbonate of soda. For some reason not connected with the physical or chemical properties of the material, uralite has practically disappeared from the market. There have appeared from time to time a number of patents for boards composed mainly of fibers and lime, but no great use seems to have been made of them.

After much study two conclusions seemed inevitable to the author: First, no homogeneous inorganic substance was likely to prove satisfactory, but that a mixture of a fiber and a cementing substance was necessary to give wood characteristics to the material; and secondly, a mixture of asbestos fiber with one or two cements (first oxide of magnesium or calcined magnesia, and second calcium silicate and aluminum mixture) seemed more suitable than any other combination.

The author proceeds to describe what he calls asbestos wood made under his patents and developed from the application to mixtures of certain processes of mixing, pressing and curing. It is stated to be practically incombustible, harder than natural woods, to have a transverse strength about two-thirds that of white pine with the grain, and, without being brittle, an elasticity less than that of natural woods; the coefficient of thermal conductivity has been found in English units to be between 50 and 30 B.t.u per sq. ft. per 24 hours, per 1 deg. fahr.

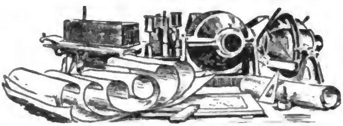
The weight of the several grades of asbestos wood 1 in. thick varies from 8 lbs. to 13 lbs. per sq. ft. White pine 1 in. thick when dry weighs approximately 3 lbs. per sq. ft., and oak about twice as much. The transverse strength of boards and the maximum fiber stress is between the limits of 5,000 lbs. and 10,000 lbs. The tendency of the material to absorb water varies between the limits of 4 per cent. and 20 per cent.

The operations of boring, sawing and finishing are all somewhat more difficult with asbestos wood than with the natural woods. It withstands scraping and rubbing much better. Floors and stair treads made of the material wear well, but are liable to be slippery when wet.

Many of the common wooden details of modern buildings have been successfully duplicated in asbestos wood, doors usually being hollow to save weight. Wherever there is danger of ignition of wooden framework a lining of the material has been found effective, notably in the vicinity of electric apparatus.

New Railroad Construction

Two new reinforced concrete viaducts are soon to be built by the Lackawanna Railroad. The contract for the construction of the Tunkhannock double track viaduct, 2230 ft. long and 239 ft. in height from rail to water line, and containing approximately 160,000 cu. yds. of concrete, has been awarded to Flickwir & Bush, of New York. The Martins Creek structure, 1518 ft. long and 150 ft. in height, water line to base of rail, built for three tracks, and containing approximately 80,000 cu. yds. of concrete, will be built by the F. M. Talbot Company, of No. 1 Madison Ave., New York City. Construction work on these structures will begin at an early date.



PATENTS

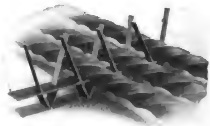
The following patents relating to cement and concrete have been granted by the United States Goverment during the past month. Illustrations and specifications of any of the patents mentioned in this Department will be forwarded on receipt of 25 cts. to cover costs. Address Royal E. Burnham, 857 Bond Building, Washington, D. C.

1,020,470. Tie and rail-fastener. Jacob J. Zipfel, Loleta, Pa.
1,020,586. Shingle-mold. Edgar M. Walton, Kansas City, Mo.
1,020,645. Concrete structure. Charles R. Hall, Seabeck, Wash.
1,020,676. Draw-bar for concrete structures. Charles C. Allen, Nebraska City, Neb.
1,020,747. Mausoleum construction. Valentine Dietz, Jr., Yonkers, and Charles F. Dietz, New York, N. Y.
1,020,919. Hollow concrete wall. Wilmot Lake, Washington, D. C.
1,020,973. Concrete railway cross-tie. William W. Frisholm, Leadville, Colo.
1,021,009. Sand-washing apparatus. Louis M. Speer, Pacific, Mo., assignor of one-half to Noah Q. Speer, Berkeley Springs, W. Va.
1,021,041. Conduit. William G. Fargo, Jackson, Mich.
1,021,140 Concrete fence-post. Robert H. Forsyth, Curranville, Kans.
1,021,368. Means for forming concrete steps. John R. Long, Akron, Ohio, assignor of one-half to Albert Roren, New York, N. Y.
1,021,405. Facing-tile. Francis C. Gideon, Ballston, Va.
1,021,429. Reinforced concrete. William Fry Scott, Toronto, Ontario, Canada.
1,021,433. Concrete railway-tie. Andrew Stark, Chicago, Ill.
1,021,443. Mold for concrete walls. Anthony Barone, Mount Morris, N. Y.
1,021,548. Concrete skylight, vault-light, and floor-light. Logan Willard Mulford, Narberth, Pa.
1,021,552. Tile structure for reinforced-concrete floors. Julian S. Nolan, Highland Pack, Ill.
1,021,557. Surfacing-trowel. John B. Runner, Indianapolis, Ind., assignor of three-fifths to Edward E. Gunckel and Frank L. Hickman, Jay County, Ind.
1,021,569. Composition for waterproofing concrete. Walter Clement Bladen, Newark, N. J., assignor to Aaron C. Horn, New York, N. Y.
1,021,623. Cement vault. Franklin S. Nixon, Phillipsburg, N. J.
1,021,666. Sleeper. George Dorffel, Oakland, Cal.
1,021,780. Fireproof floor construction for buildings. Ernest V. Johnson, Chicago, Ill.
1,021,806. Apparatus for constructing concrete piers, walls and the like. Samuel L. Shaffer, Philadelphia, Pa.
1,021,831. Cross-arm for telephone or telegraph poles. John Reed Ferringer, Emlenton, Pa.
1,021,845. Steel and concrete railway-tie. William F. Morrison, Cowell, Cal.
1,022,282. Roofing-tile machine. Otto Walter, De Kalb, Ill.
1,022,285. Machine for making cement pipes of any sectional form. Ferdinand Wienberg, Copenhagen and Lars Jorgensen, Carsten Jespersen and Jorgen Kristian Jorgensen, Elsinore, Denmark.
1,022,484. Fence-post mold. Theodore H. Kruse, Arvada, Colo.
1,022,607. Stroking attachment for concrete-mixing machines. Frank W. Swautusch, Butler, Ind.
1,022,826. Anchor for concrete construction. Franklin Chatfield, Minneapolis, Minn., assignor of one-fourth to E. J. Couper, one-fourth to F. M. Stowell, and one-fourth to C. L. Pillsbury, same place.
1,022,841. Building construction. Secondo Giletti, East Oakland, Cal.
1,022,850. Concrete-reinforcing bar. Daniel Kerr, Youngstown, Ohio.
1,022,890. Tie and rail-fastener. William T. Smith, Swissvale, Pa.
1,022,933. Tile-machine. Jacob B. Engstorm, Manchester, Iowa.
1,022,960. Adjustable mold for culverts and bridges. Peter C. Merillat, Winfield, Iowa.
1,023,059. Building-material construction. Abraham M. Zimmers, Baltimore, Md.
1,023,118. Cement vault. William H. Bales, Farmland, Ind.
1,023,149. Reinforcing means for composite structures. John F. Havemeyer, Ardsley-on-Hudson, N. Y.
1,023,163. Hollow section. Phillips Bathurst Motley, Westmount, Quebec, Canada, assignor to himself, Charles Nicholas Monsarrat, and John G. Sullivan, same place.
1,023,336. Apparatus for producing concrete pipe with waterproof lining therein. George F. Salsburg, Arcadia, Cal.
1,023,349. Method and apparatus for constructing concrete buildings. Robert H. Aiken, Winthrop Harbor, Ill., assignor, by mesne assignments, to Aiken Engineering Company.
1,023,429. Core for making concrete culverts. John W. Kempf, Goehner, Neb.
1,023,465. Mold for tanks. Edgar P. Fox, Greeley, Colo.
1,023,512. Tile-press. Secondo Giletti, Oakland, Cal.
1,023,526. Partition and wall furring. Henry Oliver, New York, N. Y.
1,023,656. Tile-molding machine. Adam Kern, Frankenmouth, Mich.
1,023,724. Concrete-mixer. Melvin E. Crandall, Northfield, Minn.
1,023,748. Building-block. Edward J. McGettigan, Cleveland, Ohio.
1,023,778. Concrete-block-molding machine. Sam Allen and Frank L. Bailey, Okmulgee, Okla.

Automatic Inspection of Concrete Reinforcement

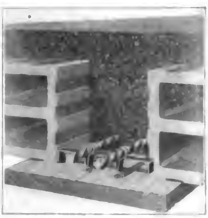
When you, the architect, specify that all reinforcing bars shall be supported, spaced and locked with Securo Supporting Spacers, you are providing for an inspection of the reinforcement, as to accuracy of location, which is absolutely AUTOMATIC, ***because***—

The Securo ***supports*** the bars the correct distances from the bottom of the slab, ***spaces*** them accurately from center to center, and ***locks*** the bars in place. It is impossible for the bars, once set and locked, to be displaced by the pouring of the concrete. That's an ***automatic inspection***—absolutely no chance for errors and inaccuracies on the job which jeopardize the safety of the structure and reflect upon the architect who designed it.



SECURO BEAM SPACER

M/B Securo Supporting Spacer



SECURO TILE JOIST SPACER

You have the satisfaction of knowing in advance that ***every*** bar in ***every*** slab, beam or joist throughout the entire structure, will be located in the exact position where its full effectiveness will be realized, and that the building when completed will have the full structural strength provided for by you in your design.

As the Securo is such a simple and practical means of protecting the owner as well as your own reputation, it seems that you should specify it invariably on every job of reinforced concrete designed by you. It is the only device which serves the purpose, there is not a single working objection to its use, and it affords many advantages and economies in construction.

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JUN 6 1912

Cement Age

A MAGAZINE DEVOTED TO THE USES *of* CEMENT

with which is combined

Concrete Engineering

VOL. XIV JUNE, 1912 NO. 6

CEMENT AGE and CONCRETE will consolidate, beginning with the July issue. See Editorial Page for Details.

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15 Cents a Copy *$1.50 a Year*

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CEMENT AGE

Established 1904, with which is combined

CONCRETE ENGINEERING *Established 1907*

ROBERT W. LESLEY, Editor; ALLEN BRETT, Managing Editor; E. A. TREGO, Associate Editor; F. F. LINCOLN, Business Mgr.; R. M. BABBITT, Western Mgr.; A. B. HENRY, Circulation Mgr.

VOL. XIV JUNE, 1912 No. 6

THE JUNE ISSUE

PRE-CAST PILES have been used extensively on Government work in Honolulu, and in this work a new mold has been developed. An octagonal pile is used, and the sections of the mold are joined by a hinged yoke, which makes for easy assembling and removing.

COMPARISON OF DIFFERENT BUILDING CODES: A good portion of the building codes of our cities is today given over to reinforced concrete. In this article, an analytical comparison has been made of the principal features of seven recent codes.

A CONCRETE RESERVOIR for the high pressure system of San Francisco has been recently completed. This is a basin with sloping sides, and divided into two sections by a buttressed wall. Waterproofing this buttressed wall involved interesting features.

A CONCRETE HOME built in a New York suburb by a well-know engineer has illustrated strikingly the value of this material. Monolithic construction was used.

MIXING CONCRETE properly is a matter which merits the careful attention of all engineers and constructors using this material. Time is an important element, and the proper consistency should be definitely established. Machine mixing is undoubtedly superior in every way to hand work.

STEEL COLUMNS PROTECTED BY CONCRETE have been investigated in an elaborate series of tests at the university of Illinois, and the results are very valuable in data on present-day design.

GOVERNMENT STANDARDS FOR PORTLAND CEMENT have been finally adopted and are published in full.

GRINDING CEMENT MATERIALS involves mechanical problems of much interest, and the development toward the use of larger grinding units has been cumulative. A large unit recently developed is described in detail.

READ THE ANNOUNCEMENT

ON PAGE 273

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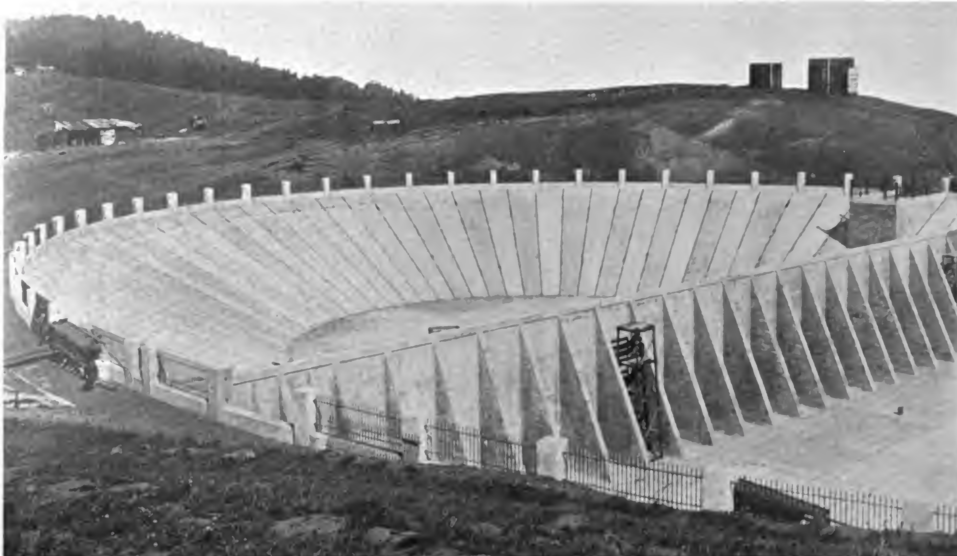


TWIN PEAKS RESERVOIR, SAN FRANCISCO.
This reservoir is 750 feet above the business section of San Francisco, and is part of the high pressure system for fighting fire.
See article on page 277.

CEMENT AGE *with which is combined* CONCRETE ENGINEERING

A Monthly Magazine Devoted to the Uses of Cement and Concrete

VOL. XIV JUNE, 1912 *No. 6*

CEMENT AGE AND *CONCRETE* WILL CONSOLIDATE

"THERE are too many papers in the cement field." This remark has been heard so often by publishers of periodicals devoted to cement and concrete that it has become a commonplace. The truth underlying the statement cannot be questioned. When nine or ten journals scattered over the country are all attempting to cover the same field in substantially the same way, the waste of effort—the duplication of the energy and expense becomes self-evident.

Recognizing this fact, the publishers of CEMENT AGE took the first step toward diminishing the number and improving the quality of the journals in this field when they purchased, eighteen months ago, the assets of *Concrete Engineering* — a paper founded on a big idea, but born ahead of its time. Since *Concrete Engineering* was merged with it CEMENT AGE has enjoyed a far greater measure of prosperity than ever before. The great majority of the subscribers and advertisers of both periodicals have approved the action and the publishers of CEMENT AGE have reason to believe they did a wise thing.

Another step in the same direction is about to be taken. Beginning with the July issue CEMENT AGE and *Concrete* of Detroit, will be consolidated. A new corporation will take over the property owned by both periodicals and will publish a bigger, broader and more truly representative journal to be known as CONCRETE-CEMENT AGE.

The new journal will not only be physically bigger (that is, contain more pages of reading matter and illustrations) but will be vastly stronger, as a result of combining the editorial staffs of both the periodicals involved. It will have greater resources and will do better work in presenting to the combined lists of subscribers, reports of the progress being made throughout the world in the cement and concrete industry.

All the valuable departments and features that have made both CEMENT AGE and CONCRETE ENGINEERING popular in the past will be continued. The subscriber will get more for his money, and the advertiser will obviously get more for his.

The publishers of both the journals involved in this merger realized that they were working along very similar lines, that each periodical contained much that would strengthen the other, and that although each was meeting with success to a gratifying extent, the joining of forces would achieve at once what it would otherwise take years to accomplish.

The publishers of CEMENT AGE wish to take this opportunity of the knowledging their indebtedness to acsubscribers and advertisers who have made the magazine possible throughout the eight years of its existence, and they anticipate the cordial approval of all friends of CEMENT AGE in the step about to be taken.

A NEW FORM AND REINFORCEMENT FOR CONCRETE PILES

THE rapidly increasing costs of wooden piling and the lack of skilled labor, as well as the desire to secure a truly permanent work prompted the development of a novel reinforced concrete pile and a novel form for molding it. The method named after its inventor, Stephen F. Burbank, has been used extensively in the government work in the protection of the naval base at Pearl Harbor in Hawaii.

The pile is molded horizontally and for bearing purposes is usually made octagonal. The octagonal cross-section is adopted principally because of the simplicity of this form over that of the circular cross-section and of the ease with which it is handled. Difficulty of handling is one of the several disadvantages of the square pile.

The reinforcement is quite simple, consisting of the usual longitudinal rods and hoops and, in the longer lengths such as 60 ft. of the helical in addition. The feature peculiar to this pile is the forming of the hoop reinforcement out of a simple piece of wire independently of the assembling operation. These hoops can be made with a simple "former" (Fig. 1) adapted to any circumference and to accommodate any number of longitudinal rods (usually including a center rod or a pipe for jetting purposes) at a site either far removed from or near to the place of actual manufacture of the pile. Moreover, these hoops can be made quickly and efficiently by unskilled labor.

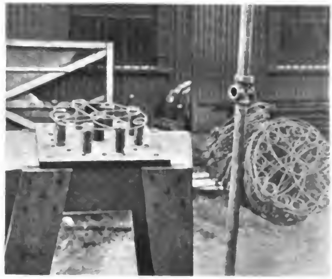


FIG. 1—PEGGED TABLE USED IN FABRICATING HOOPS.

The assembling of the hoops and the longitudinal bars can be done in the same economical fashion, the operation consisting simply of thread-

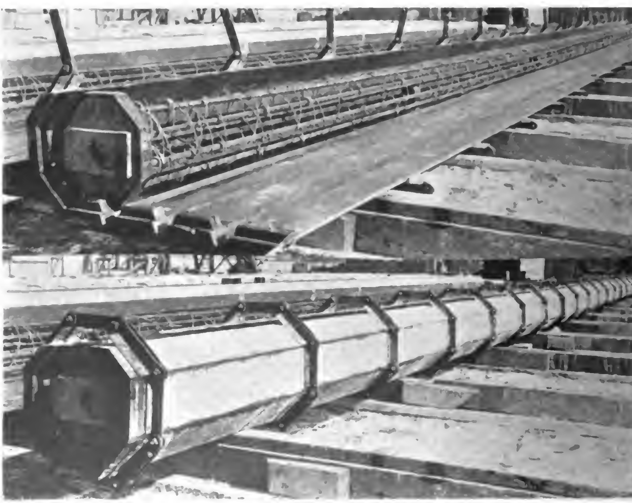


FIG. 2—THE UPPER VIEW SHOWS THE FORM "UN-ROLLED," AND THE STEEL IN PLACE.

ing the rods through the eyes of the hoops after which the hoops are strung along at any desired distances which may be laid off with the usual measuring stick. At the head and at the point of the pile the intervals are decreased so as to provide against brooming.

The reinforcement can either be assembled in the mold itself, or having been assembled at a short distance from the place of pouring the concrete, it can be carried to the mold without deformation due to the fact that the hoops are sufficiently stiff to retain the shape of the entire reinforcement. The first method is preferred, since when assembled it is practically in place and the operation requires very little time—the great advantage of this system.

This advantage is increased by the peculiar type of mold used. It consists essentially of seven sides of an octagonal-shaped box (the eighth top-side left open for pouring) either of wood planks or of steel plates. These sides are secured in their relative positions, whether closed or lying flat on skids, by endless chains. The mold is spread out flat by simply removing one bolt from one end of each of the top links.

With this understanding of the mold it is readily seen how, with the mold in its flattened position, the reinforcement can be assembled on the bottom side of the octagonal form, the mold then closed and fastened by passing the bolts through the ends of the top links. The reinforcement can then be raised up in the cavity to its proper position and secured by wires to these top links.

This last mentioned feature is another great advantage, in that since the mold has a depth only of the diameter of the pile and the top side is open, the reinforcement can be hung where desired with the positive assurance that it is exactly equidistant from the circumference and will be there when the pile is completed.

The above operations completed, the concrete is poured into the form and the top side is straight-edged under the top link, using as screeds the edges of the sides adjacent to the pouring opening.

The next step shows a still further advantage of the system. After the concrete has set sufficiently—usually 24 to 48 hours (although 12 hours only has been allowed on some works with perfectly satisfactory results) the mold with its contained pile is rolled over until the bottom (formerly the top or exposed side of the pile) rests on supports previously made ready to receive it. The bolts are then removed from the ends of the top—now bottom—links and the form or mold removed and used again. If a reasonable amount of care be exercised, there is no danger in this last operation, due to the fact that the pile is always supported by the mold until it rests on the skids or plank on which it is finally deposited. The pile is then cured for 30 days preferably, although some have been driven with gratifying results after only seven days' curing.

The deterioration of the molds—even those of wood—is very slow, due to the fact that the members are always retained in their relative positions and are stressed only to a small extent. If the wooden molds are oiled before use they will last indefinitely with very slight cost for repairs.

The roughest treatment to which a pile is subjected is that of driving, more especially when the pile is being driven home hard. The bearing power is far in excess of any probable requirement in

FIG. 3—A FINISHED PILE IS SHOWN ON THE LEFT. AT THE RIGHT A DETAIL OF THE LINKED HOOPING.

practice. The danger lies in the brooming and splitting of either the head or the point. This contingency is provided against in this pile by more closely spacing the hoop reinforcement and by drawing together the ends of the longitudinal rods at the point. This pile in practice has been successfully driven through boulders and through coral ledges varying in thickness from four inches to sixteen inches, and has withstood without damage to either the point or the head, the continued driving of a five ton steam hammer although there was no penetration during this punishment.

The inventor and patentee is Stephen F. Burbank, of Honolulu, Hawaii; the Burbank Concrete System, with offices in the Century Building, Washington, D. C., handles the pile and mold.

REINFORCED CONCRETE IN SAN FRANCISCO

By George Mason*

The accompanying photographs are the front and rear elevation of a five-story reinforced concrete hotel of 100 rooms, large lobby, two stores and basement now being built in San Francisco. The building is one of several owned by G. G. Burnett Estate Co., and is located in a prominent part of Market Street, San Francisco's main business thoroughfare.

C. H. Skidmore, the architect, has designed many San Francisco structures of this character. H. C. Warwick, the contractor, is erecting the entire building, and with the writer, is giving constant attention to all details of construction. Before plans were drawn the owners spent several weeks in consultation with the architect and mechanical engineers and after an exhaustive investigation decided then that reinforced concrete fireproof construction was most suited to their needs. It is said that the Burnett Building, owing to strict requirements of the architect and careful execution by the contractor, is one of the strongest and most substantial buildings in the city.

The formwork has been built at the rate of one floor each five days, after which each floor was poured in five and one-half hours. The contractor is one month ahead of his contract time and expects to deliver the completed building to the owners in less than five months from the day of commencement.

[A careful study of the forms in the front elevation, shows that instead of 4 x 4 uprights under the wall girders, a pair of what might be 2 x 4s are used. Note that the centering is left in for four floors.—EDITORS.]

*Superintendent for H. C. Warwick, Building Contractor, San Francisco.

FRONT AND REAR ELEVATIONS DURING CONSTRUCTION OF BURNETT BUILDING, SAN FRANCISCO.

Weight of Concrete

In a recent report issued by the Bureau of Standards, the weight per cubic foot of concrete as molded into beams for flexure tests and into cubes and cylinders for comparison tests is given. The specimens were weighed at the ages of 4, 13, 26 and 52 weeks and for each age generally 21 specimens were averaged. As the concrete showed no increase of weight with age we give below only the general averages as follows:

Kind	Beams lbs.	Cylinders lbs.	Cubes lbs.
Granite concrete	148	148.6	147.7
Limestone concrete	146.6	146.7	145.7
Gravel concrete	144.1	144.8	144
Cinder concrete	119	119.3	118.1

CONCRETE RESERVOIR FOR FIRE PROTECTION

TO make impossible a recurrence of the 1906 disaster, San Francisco has recently completed at Twin Peaks the concrete reservoir shown in the frontispiece of this issue. The reservoir is in the shape of an oval cup in an excavation on Twin Peaks and towers over 750 ft. above the level of the business section of the city. It is 370 ft. long by 285 ft. wide and 27 ft. deep. When filled it holds 11,000,000 gal. and will be used for the high-pressure system.

An interesting feature of the tank is the buttressed division wall, dividing the tank as shown in the illustration. With this wall one-half of the tank may be emptied at any time for cleaning or repairing. The buttresses are uniform on both sides of the wall, and are 1 ft. thick, extend out 13 ft. at the base, and are 9 ft. on centers. It was planned to fill one-half of the reservoir with water and hold a public reception on the day of dedication in the other side. When the reservoir began to be filled and there was about 6 ft. of water in it, they found the wall leaked badly and that it would be impossible to proceed with the plans of the celebration. To waterproof this one-foot wall, the "cement gun" was employed and with it a coating of sand and cement was applied to the wall and buttresses on both sides, averaging ¼ in. at the top and increasing to ½ in. at the bottom. A mixture of one part of Portland cement to three parts of graded sand with the addition of a small percentage of hydrated lime used. The concrete was thoroughly wet down before applying the mortar, and as far as possible this was kept wet after being applied. There was, however, some difficulty owing to a shortage in the water supply and also to the high winds that prevailed the greater part of the time, which had a tendency to dry out the mortar coating very rapidly.

Three thousand two hundred sq. yds. were covered, and the job was completed in eight days, employing one "gun" continuously and a second "gun" about half the time. Immediately on the completion of the work, water was pumped into one-half of the reservoir by the auxiliary pumping station at Second and Townsend Streets, at the rate of 2,000 gallons per minute until it was filled to a depth of 25 ft. 6 in. At the end of twenty-four hours, a slight seepage of moisture was indicated by the appearance of a few damp spots on the wall and at the junction of the mortar coating and the floor. In forty-eight hours this slight seepage ceased and the damp spots disappeared. The result indicates that sand and cement applied by compressed air as is done with the cement gun, fills the voids and makes a concrete so dense as to be perfectly waterproof.

On Sunday, May 12, the reservoir well decorated with flags and bunting was dedicated, and while one-half contained 25 ft. 6 in. of water, the other half was used as an auditorium in which to hold the exercises. The waterproofing work was done by the Pacific Cement Gun Co., of San Francisco.

DESIGN OF FORM MAKERS FOR ECONOMY

It is generally recognized that one of the prime reasons for the comparatively high first cost of reinforced concrete buildings is the cost of the material and labor put in the forms. Therefore continued efforts to reduce this item to a minimum are being made by many construction companies. A recent case is illustrative of the possibilities of saving even on small jobs by designing the forms in the drafting room instead of putting the fitting up to the carpenter shop.

The job in question was a small structure costing about $26,000, and 50 ft. by 50 ft., four stories high, and built by the Aberthaw Construction Co., of Boston. The design was of the beam and girder type and was made as regular as possible in order to keep the cost down. In spite of this, 113 different kinds of forms were required, making a total of about 600 forms in all taking about 10,000 sq. ft. of stock. When it is considered the figures do not include any of the ledges, studs, or anything but the beam and column sides, it will be appreciated that 113 different kinds of forms is a large number for a plain small job.

By former methods, the carpenters usually not only made the beam sides but fitted them as they went along, and each one had to be sawed out. A large saving is therefore made by designing the forms for this small job in the drafting room as the cost of drafting is very much less than the cost of making up the beams and fitting. It is very probable that the failure of new concrete contracting companies is often due to their ignorance of economical methods of handling form work and the case above is an excellent illustration of how they might go astray on their estimate by not realizing the high cost of the many forms on such a small plain job.

PRESERVATION OF IRON BY CONCRETE

Many proofs have been given of the perfect condition of iron after having been embedded for long periods of time in concrete. Another illustration has lately been furnished by the examination of a portion of the reinforcement of a concrete building in Paris, dating from 1852. This is a three-story building, the roof of which is a reinforced concrete slab about 12 in. thick, with a minimum span of 20 ft., the reinforcement consisting of small I-beams, about 3¼ in. deep. About thirteen years ago a hole was cut in one of these roof beams and the concrete removed down to the iron, which was found to be clean and free from rust, and the hole was filled with fresh concrete. Quite recently this thirteen-year-old concrete was removed and on examination the iron was again found to be in perfectly good condition. The entire absence of corrosion after a period of sixty years is a sufficiently convincing testimony of effective preservation.—*Ferro-Concrete.*

A REINFORCED CONCRETE RESIDENCE

DURING the season of 1907 a residence having solid reinforced concrete exterior walls, with the interior plastering placed directly on the concrete, was built in Yonkers, N. Y. The foundation walls to a height of about 2 ft. above the finished earth surface, are of rubble masonry 18 in. thick, using stone taken from the cellar excavation, laid in Portland cement mortar. Floors, piers and exterior steps are of reinforced concrete, and most of the partitions of hollow terra cotta blocks. Parts of the attic partitions and two or three small pieces elsewhere to accommodate plumbing pipes are of 2 x 4 in. spruce studs and metal lath. Hardwood floors were laid on the concrete floor slabs in most rooms. The exterior walls are covered with a pebble dash of La Farge cement and small pebbles. Red tiles cover the steeply sloping sides of the roof and the large deck is covered with canvas laid as on a ship deck. Ground was broken March 18, 1907; cement shed and concrete forms were begun April 8; the cellar wall was started about May 1, and the house has been occupied since December 20, 1907. So far it has proved entirely satisfactory.

The house is 42 ft. 4 in. square outside with no projections except a 6 x 9 concrete porch and two bay windows on the first story front. There are two stories, cellar and attic, the first story being 8 ft. 6 in. from floor to ceiling and the others 8 ft. A 12 x 20 ft. veranda is included within the square of the plan on the first floor, and an 11 x 12 ft. loggia on the second floor. These are enclosed with sash during cold weather, but open during the summer. A 9 ft. hall extends from porch to veranda, with a 15 ft. 6 in. by 28 ft. 6 in. living room on the southerly side and dining room, serving pantry and kitchen on the north. The foundations throughout rest upon ledge rock. A terrace wall and terrace were built around the house of the surplus rock and the earth from the excavations. A parapet of concrete blocks surmounts the terrace wall, and the whole was plastered with rich cement mortar and given a wash of La Farge cement grout. The service chimney is of concrete from foundation to cap. Two other chimneys for fireplaces and furnace are exterior chimneys, built of common brick, plastered with cement mortar and washed with La Farge cement. All have liberal flues and consequently good draft.

Exterior walls are 8 in. thick, reinforced with vertical and horizontal ¼ in. rods spaced about one foot apart, and ¾ in. or smaller horizontal rods over the openings, according to the span. Floor slabs are 4 in. thick reinforced with 5/16 in. rods 7 in. on centers both ways, wired together at intersections. Beams carrying the first floor are of short span, being supported by frequent piers 10 in. square and the cellar walls.

So far as practicable beams carrying the second and attic floors were placed in the partitions and made of corresponding thicknesses. In the dining and living rooms two beams spanning the room and symmetrically arranged are exposed in the ceilings. A similar beam is exposed in the kitchen. It was not desired, however, to have beams appear in the ceilings of chambers, and therefore such as could not be placed at partitions were built to project 4 in. above the top of the attic floor slab, thus giving them a total depth of 8 in. Such "up" beams were made much wider and reinforced more liberally because of their shallow depth and because no part

FIG. 1—REINFORCED CONCRETE RESIDENCE AT YONKERS, N. Y.

of the slab could be reckoned as compression flange. These up beams are covered by the wooden floors. Ends of beams are carried by concrete piers built in the partitions or by girders between piers, where not supported by the outside walls. Beams are reinforced with ¾ in. rods made up into triangular trusses by means of stirrups of ¼ in. rods spaced about a foot apart near the ends and farther apart near the middle of the span. In each beam some of the large rods were bent up near the end to care for the shear, and the "up" beams were reinforced for compression. Piers were reinforced with vertical rods of sizes adapted to the loads.

Plain round mild steel rods were used throughout for reinforcing the concrete. The concrete was mixed by hand, quite wet, of one part Portland cement, two parts Cow Bay sand, and four parts Clinton Point broken trap rock. All forms were of wood, made on the job; many of the form boards were subsequently used for roof boarding and other purposes, and the 2 x 4s were utilized as sleepers for the wooden floors on top of the concrete floor slabs. To hold these sleepers in place and serve as a sound deadener very lean cinder concrete was used, and before laying the hardwood flooring, sheathing paper was put down on top of the sleepers.

Exterior walls were built in lifts of a few feet. the forms being used over and over. A complete form was built for the first floor slab and used in turn for the second story and attic. Special effort was made to have each floor slab monolithic by continuous laying. Forms were lubricated with soap, no grease nor oil being permitted. This precaution was taken to insure the adhesion of the plaster and stucco. After five years, including one or two unusually severe winters, no peeling nor cracking has occurred. Concrete was protected from the sun and kept moist or wet for some time after removal of forms.

For elevating concrete to the upper floors and walls, a heavy iron ash can was used on a simple block-and-fall hoist operated by a horse. The stucco of cement and washed roofing pebbles was applied with the usual pebble dash brushes, but not until practically all other work on the house was completed, except interior finish. As anticipated, this stucco promptly and generally crazed with a close network of fine cracks. After the first winter, in April, the walls were given a thorough coat of the same cement grout, mixed neat to about the consistence of thick kalsomine, thus filling all the crazing cracks. Painters were employed for this. Just in

FIG. 2—ANOTHER VIEW OF CONCRETE RESIDENCE AT YONKERS.

advance of the grout coat the walls were washed and kept moist, but not too wet, and afterwards were sprinkled with a fine spray of water repeatedly so as to prevent too rapid drying. This was entirely successful.

A gray pulp plaster* was used for all coats, the finish coat having no pulp. If properly cared for this plaster leaves the walls with a pleasing appearance without other finish. On the ceilings only the thinnest possible coat of finish plaster was used; there has been no cracking nor peeling.

Staircases and window and door trim are all of wood. The exterior trim is painted a foliage green. The roof has a broad overhang, as indicated in the pictures; the under side of this is painted a light yellow, which gives a pleasant tone to the light reflected into the rooms.

No waterproofing of any kind was put into or on to the concrete or on to the stone cellar walls. Skillful selection and mixing of good materials accomplished such a high degree of weatherproofness as to leave nothing to be desired. Through bolts were permitted in the wall forms, but are not recommended because they require excessive watchfulness to make sure that every hole has been satisfactorily filled. Sand streaks and laitance must also be scrupulously guarded against.

This house is situated on top of a high hill and the lot was unusually difficult to build upon, because of its topography. Hence cost figures would have very little value to others. In general, it might be said that the house cost little if any more than a well built brick house of equal quality.

*Made by the New York Pulp Plaster Co.

CONCRETE ROADS*

By Logan Waller Page†

FOR some years the best practice in city streets construction has called for Portland cement concrete foundations. Used for this purpose, concrete has proved more satisfactory than any other material, and no improvement could reasonably be expected.

During the past ten years probably more experiments with road materials have been made than in any other period in the world's history. The new traffic conditions brought about by the automobile have almost completely upset our standards for rural and suburban roads. During this time much experimenting has been done, with the object of making concrete available as a road material. Up to the last four or five years, however, I think it can be safely said that concrete as a road surfacing material has in most cases not proven to be altogether satisfactory.

While this is true in general, yet there are isolated instances where concrete has been used for road construction with such a degree of success that complete success seems to be almost in sight. This fact alone, it seems to me, justifies an assumption that concrete can be made generally successful as a road material, provided sufficient care is used in the selection of materials, their mixing, laying and curing, all of which necessitates skilled supervision.

I believe one reason why so many concrete pavements have failed in the past is because the concrete has been improperly cured before traffic has been allowed upon it. We know that concrete cured under water attains a greater ultimate strength than that cured in air. For this reason I would recommend a fairly wet mix and for a period of from one or two weeks after the concrete has been laid that the surface be kept thoroughly moistened by sprinkling. If provision can be made for keeping the sun from coming directly on the surface, this should prove very beneficial. This protection can be accomplished by covering the surface of the concrete with loam or other soil of which the shoulders of the road are composed. True, such protection will add to the expense of the pavement, but I believe the additional cost will be more than offset by the increased strength of the concrete. In the case of city pavements, this protection might be accomplished by covering the surface with straw, sawdust, or shavings. It occurs to me that further opportunity for the concrete to gain additional strength would be provided at slight expense if, after the curing just mentioned has been completed and the loam or soil has been removed and the surface allowed to dry, a thin coat of bituminous material be immediately applied. This form of construction was used at Ithaca, N. Y., by the office of Public Roads in 1909, and I am told, at Ann Arbor, Michigan, for the past three seasons. It seems to me that it would materially lessen the shocks from traffic, and if only one bituminous coat were applied and allowed to wear off, it would be worth the additional cost as a protection to the new concrete. Further, it holds the moisture in the concrete.

Experiments indicate that concrete upon drying, exhibits shrinkage, and at the end of six months, the shrinkage amounts in fairly dry concrete to 3/4 of an inch to the 100 feet. This is as much contraction as would be caused by a change in temperature of over 100°F., showing that the effect of moisture in causing the cracking of concrete is certainly as great as, if not in excess of, that due to change in temperature. If means could be provided for preventing the drying out of the moisture, much of this shrinkage would be prevented. The consequence would be a more solid mass of concrete.

The bituminous top just described would prevent the rapid drying out of the concrete mass, and, therefore, prevent the formation of many of the cracks which would otherwise occur. Provided cracks did occur, the bituminous covering would be immediately driven into these cracks by traffic, and the cushioning effect of the bituminous top would prevent chipping and spalling of the concrete at these cracks.

Undoubtedly, provision must be made for expansion and contraction. While unable to state exactly what this allowance should be, the best practice up to the present time seems to call for an expansion joint 3/8 of an inch to 1/2 of an inch along each side of the pavement at the curbing in the case of streets, and a transverse expansion joint about every 25 feet. Experience may show us, however, that these transverse joints can be placed further apart.

My examination of concrete pavements so far laid has indicated that a transverse joint of half inch filled with suitable paving pitch makes a satisfactory joint, and prevents chipping at the edges of the concrete.

On account of the dense surface, a crown of 1/4 inch to the foot is probably sufficient for concrete pavements. Such a flat crown is very desirable on any pavement, on account of its tendency to distribute the traffic over the entire width of the pavement. By the use of different floats, almost any kind of a surface finish can be obtained. For ordinary traffic, of course, too smooth a surface is not desirable, on account of its tendency towards slipperiness.

One feature of the best Portland cement concrete pavements that looks particularly interesting is the probable low cost of maintenance. I have reports from the city engineer of Portland, Maine, of seventeen sections of concrete pavement built by the Grouting method, the oldest of these pavements having been laid in 1907. Several sections have been laid each year since. The reports indicate that there has been no maintenance expense on any one of these sections. Portland is a city of about 55,000 inhabitants, and many of these concrete sections are subjected to excessive traffic on streets with double car tracks. Several other instances have been brought to my notice where substantially no maintenance charge has obtained on concrete pavements from three to five years old, and where the wear is practically slight.

Figures collected by the Office of Public Roads relative to the cost of maintenance of plain macadam and bituminous macadam pavements under fairly heavy traffic conditions indicate that these pavements, when properly maintained, entail an annual absolute maintenance charge of approximately $450 per mile per annum for plain macadam, and possibly from $800 to $1,000 per mile per annum for bituminous macadam, for 15 feet surfaces. These figures have led me to believe that we must seek a more perma-

*Delivered before the American Association of Portland Cement Manufacturers, Chicago, May 9, 1912.

†Director, U. S. Office of Public Roads.

nent form of pavements for country road surfaces. I hope that the concrete road will meet this requirement.

In the matter of sustaining normal loads the capacity of concrete pavements as compared with the capacity of ordinary macadam or bituminous macadam surfaces, must be superior. Numerical data or experimental evidence on this subject is as yet meagre. It is not difficult, however, to draw certain definite conclusions when we consider the nature of the materials involved. It is well known that macadam roads have rutted under heavy loads. For ruts to develop rapidly it is quite evident that some shearing of the macadam surface occurs. Of course, rutting also takes place, because of wear and lateral displacement of stone. The capacity of concrete pavements to resist shear is relatively much greater, and we may perhaps note this is the first point of superiority of concrete over macadam pavements for sustaining normal loads.

It is common practice to assume, in designing concrete bridge floors that normal pressures over an area are transmitted through the slab in lines of pressure whose boundary surface is conical; with elements at an angle of 45 degrees or more with the horizontal. It scarcely needs demonstration that the same assumption cannot hold for macadam slabs, i. e., normal pressure cannot be transmitted by a macadam slab over as large an area of the subgrade, and this, it is reasonble to record, is a second advanthge of concrete over macadam construction.

We may, if we choose, compare concrete road surfaces with macadam road surfaces, assuming that each is an arch between curbs. It is not difficult to see that concrete is superior as an arch in the following way: Consider the entire sub-grade carefully removed from a macadam road surface; there is some doubt as to whether the macadam surface would stand alone. On the other hand it is easy to see the complete concrete slab crown not only standing after the removal of the sub-grade, but to also see this arch of concrete sustain considerable load without a sub-grade, so that we must admit the third superiority of concrete roads over any macadam construction in their action as an arch to sustain normal pressure.

Up to the present time, we have not been concerned greatly over the presence of heavy loads upon our roads. There is now, however, evidence that we cannot place an upper limit on the loads which may be expected to travel almost any newly built road. The practice of delivering coal, for example, in large quantities by motor trucks is rapidly increasing. In the vicinity of cities there seems reason to believe that this practice may wholly supplant the delivery of coal by wagons in small lots. We must frankly admit that whatever method of transportation over roads proves the most economical will be adopted. It does not seem likely that in the long run restrictions upon the weight of loads will increase and it, therefore, is very evident that future road surfaces must be constructed with an ample factor of safety, in view of probable increase in traffic, both numerically and in unit tonnage.

From the comparisons made above between Portland cement concrete and plain macadam or bituminous macadam, it is evident that we may be practically assured that the Portland cement concrete road is far better able to meet the changing traffic conditions than either of the other surfaces. From our knowledge of the strength of Portland cement concrete, we can design a road surface of this material to meet practically any traffic requirement.

In conclusion, I desire to state that I believe concrete roads can be built that will successfully meet all modern traffic conditions, if sufficient care is exercised in construction. It may be too early to express an opinion on the maintenance costs of such roads, nevertheless, with proper supervision, I venture the prediction that they can be brought to a lower figure under equal traffic conditions, than with macadam roads.

Concrete Sidewalk in Florida

[Municipal Journal]

In Sarasota, Fla., sidewalks are constructed by the abutting owner, or, if he fails to do so after notice by the town council, by the town at his expense, the cost being a lien on his property. The obtaining of materials for walks is a troublesome problem, if anything more durable than wood is desired. There is no clay for bricks, even if these were considered desirable. Flagstones would have to be brought from some distant state at considerable cost for freight. There is absolutely no stone or gravel, oyster shells being about the only substitute. The sand available is almost as fine as talcum powder.

Under these conditions City Engineer John W. Philip has prepared specifications for constructing walks of cement, either in sheet or tile form. For the former a foundation 3½ ins. thick is constructed of a mixture of one part Portland cement to 3½ parts of clean sand or broken shell, no part of which will not pass a 2 in. ring. As soon as this has been placed it is covered with ¾ of an inch of a mixture of one part cement to 1¾ parts of sand, thoroughly mixed both before and after wetting and floated to a smooth surface. Joints entirely through the pavement are provided in the usual way.

The sidewalk tile may be of any size, but must be hexagonal in shape. If of 1 sq. ft. or less in area they must be at least 1¼ ins. thick; if larger than this, at least 1¾ ins. thick. The wearing surface must be at least ½ in. thick, composed of one part cement to one of sand; the balance to be at least one cement to three sand. Tiles must be seasoned at leat ten days before laying, and must be laid on a foundation at least 1½ ins. thick, and proportioned as for sheet cement foundation. They are to be laid within not more than two hours of the laying of the foundation, and brought to grade throughout with a straight edge. Along each edge of a tile walk must be placed a concrete curb not less than 2½ ins. thick and 6 ins. deep.

It is probable that these constructions would not stand conditions in a northern climate; but in Florida there is no frost, and the sub-foundation over the most of the eastern part of the State is sand. Cement tile walks give good satisfaction in Atlanta, Georgia, and several other cities in that and neighboring states.

As a rough estimate of the life of forms in building construction before they are worn out, Taylor and Thompson, in their new book on "Concrete Costs," suggest: walls, 16 times; columns, beams and girderse, 10 times; floor forms, 6 times, if soft lumber like spruce, or 10 times if of Southern pine. These times apply to 1-in. stock.

VALUE OF CONCRETE AS REINFORCEMENT FOR STRUCTURAL STEEL COLUMNS

IN high or very heavily loaded buildings, the size of the columns and the space they occupy become important considerations. During the past few years some designers have used structural steel columns encased in concrete. Sometimes the structural steel shapes form a relatively small proportion of the column section and are considered as reinforcement for the concrete. In other designs the amount of steel is much larger and the structural shapes will carry a large proportion of the load so that the column instead of being a reinforced concrete column is really a steel column reinforced with the concrete in which it is embedded. Such columns may occupy less space than the reinforced concrete column as usually designed.

Two points of view seem to exist with reference to columns having a large percentage of structural steel:

(a) that the concrete surrounding the steel simply affords protection from fire and corrosion and that the additional strength afforded by the concrete is not considerable in amount and is not available for design; and

(b) that if the concrete be present it must act in unison with the steel and that its strengthening effect and its effect upon the permissible deformation of the column should be taken into account. The present building codes either directly or through the relation of stresses allowed, virtually occupy the first position when the steel column forms more than 8 per cent. of the column section.

The series of tests described was planned to throw light upon the action of columns formed of structural steel shapes by filling the space between the shapes with concrete or encasing them in concrete as exemplified in a form of column section which has been used in reinforced concrete building construction.

The investigation was planned with the view of securing information on the following principal points for the section and type of column tested: (1) the effect of length and slenderness on the strength of the plain steel columns; (2) the effect of length upon the strength of similar columns made up with a core of concrete; (3) the effect of richness of concrete in the core filling upon the strength of the column; (4) the effect of adding an exterior coat around the steel section upon the strength of the column, and the action of this coat under load; (5) the effect of spiral hooping upon the strength and stress deformations of the column.

The columns tested were of a form now frequently used in building construction. The percentage of steel used (area of steel section 10.8 per cent. of the area of the octagon inclosing the structural shapes) is within the range used in building construction. The conclusions given in the discussion relate to the properties of columns which have the forms and sections of the columns tested, and variations in proportions of metal and concrete may give somewhat different results. The tests, however, may be expected to throw light on the properties of columns of the same general type within the limits of ordinary design. The principal conclusions found in the discussion are as follows:

1. The maximum load carried by the plain steel columns is expressed by the straight-line formula, $=36\,500-155$, where is the ratio of length of column to radius of gyration of the section of the steel column.

2. Earlier in the test the effect of length upon load carried at a given unit-deformation was less proportionately than at maximum load, the coefficient of in the equation being only 55 for a unit-deformation of .0008, and 27 for a unit-deformation of .0005, as compared with 155 in the equation for maximum load.

3. The load-deformation diagrams diverge from a straight line at loads well below the maximum.

4. In the concreted columns of the core type, the effect of length upon strength of column was almost identical with that found in the tests of plain steel columns. In other words the stress taken by the concrete may be considered to be nearly independent of the slenderness ratio of the column, within the limits of the lengths tested, and the stress taken by the steel may be considered to be the same as that taken by a plain steel column of the same slenderness ratio.

5. In the tests the concreted columns of the core type showed considerable toughness, though at the maximum load there was no material lateral deflection. The final failure of the concrete generally occurred at or above tie plates. The discussion shows that the concrete of the columns was less strong than the concrete of the cubes and less stiff than the concrete of the cylinders.

6. The stress taken by the concrete within the core or within the spiral is approximately equal to the strength of concrete of the cylinders tested and to two-thirds of the strength found in the 6 in. cubes.

7. The values of the ratio of the modulus of elasticity of the steel column to that of the concrete, *n*, under the assumptions used in the analysis, are much larger than are commonly used in reinforced concrete design.

8. A basis for design which seems rational is to determine the strength of the steel column by the use of the column formula for the of the steel column and then to consider the concrete of the core section (without reference to the length of the column for any ordinary length ratio, say a length of 15 diameters) to have a stress value proportional to the strength of the plain concrete, say two-thirds of the cube strength. A suitable factor of safety would of course be somewhere applied.

9. In the test of the fireproofed type of column (which had a shell of concrete outside the steel) the concrete shell remained intact until a deformation was reached as great as that developed at the maximum load in columns of the core type. This integrity of section at high deformations indicates that the presence of the shell need not impose any restrictions upon the working stresses available for

*An abstract of Bulletin No. 56, "Tests of Columns," by Arthur N. Talbot and Arthur R. Lord. Published by the University of Illinois, Urbana, Ill.

the steel and for the core concrete. Of course, there are good reasons for the use of a metal binder like wire mesh or spiral for holding the shell securely in place.

10. The discussion indicates that the stress carried by the concrete of the shell is only about half of that carried by the core concrete. This lower strength is not objectionable, since the shell is not considered in designing the column.

11. The action of the spiraled columns indicates that the spiral has little effect up to a deformation and load corresponding to the maximum load for an unspiraled column. Beyond this load the column compresses rapidly and the presence of the spiral adds materially to the strength of the column. The tests do not fix the exact amount of this added strength.

12. In view of the large shortening necessary to make the added strength due to spiraling available and the general toughness of columns of the core type, it would seem that for building construction the use of a large percentage of spiral reinforcement in columns made up of structural shapes and concrete is hardly justifiable. A moderate spiral may warrant the use of somewhat higher unit-stresses, since it adds to the toughness of the column and gives a possible higher ultimate strength, and it will also serve to tie the concrete of the shell together securely and protect it from accident, but it does not seem best to consider this spiral directly in the computations for strength of column.

13. The columns tested possess the qualities of a good structural member and seem well adapted to more general use in building construction.

These comments are made on the assumption that the concrete is placed in as workmanlike a manner as is obtainable in the construction of high-grade work in columns reinforced with longitudinal rods or with rods and spirals.

ECONOMY OF TWO-COURSE CONCRETE PAVEMENTS

S. Whinery, Consulting Engineer, New York, in an article on "Hydraulic Concrete Pavements," published in the *Municipal Journal*, says that on any street where such a pavement will be appropriate a total depth of 6 ins. of concrete will afford all necessary *strength* to carry loads, even where the sub-foundation is of poor quality; and there is no sound reason for making the lower 4 ins. of this richer than the concrete found appropriate for the foundation of other pavements; say, 1: 3: 7. The upper 2 ins. should be designed mainly to resist abrasion or wear.

The best ratio for the surface course ought to be determined for each particular material used, as we do in the case of high-class concrete, but a typical composition that should give good results is 1 :2 :4. Every care should be taken to make this surface-course concrete of high quality. Sufficient water should be used to make a *wet* but not a sloppy mixture.

Such a pavement should be constructed at a very moderate cost. Estimates will vary in different localities, but the following may be considered typical:

Concrete first course 1 :3 :7.

1 cu. yd. of stone	$1.40
3-7 cu. yd. of sand, at 90c	.39
1 bbl. cement	1.40
Mixing, laying and sundries	.90
	$4.09

This will lay 9 sq. yds. of 4 in. concrete, cost per sq. yd. .... 45.5c.

Concrete surface-course 1 :2 :4.

1 cu. yd. selected stone	$1.60
½ cu. yd. sand, at 90c	.45
1.7 bls. cement, at $1.40	2.38
Mixing, laying and sundries	.90
	$5.33

This will lay 18 sq. yds. of surface, costing per sq. yd. .... 29.6c.

Total for the two courses..... 75.1c.

It is interesting here to compare this total with the cost of a single 6 in. course made in the ratio of 1: 2½: 5, which is probably leaner than most engineers would care to use for a pavement laid in a single course:

1 cu. yd. of stone	$1.40
½ cu. yd. sand, at 90c	.45
1.35 bbl cement, at $1.40	1.89
Mixing, placing and sundries	.90
	$4.64

This would lay 6 sq. yds. of surface, costing per sq. yd .... 77.3c.

From this it appears that the two-course pavement is slightly cheaper than the one-course.

Forms Required

The number of sets of forms to make up for any building varies with the speed of construction required, weather conditions, and shape of building. On an average 1½ sets of forms is a fair allowance. With this number, erection on the floor above can begin while the concrete below is green, so that in good weather a story can be built in a week or ten days.

Some large building contractors have adopted the use of only one set of forms in a building, whether it be 2 stories or 10 stories high, with additional lumber for girder bottoms and supports that must be left in.

A building of large floor area may be built in sections, setting up, say, one-half of a floor area at a time, so that forms for only about three-fourths of one floor are needed with the extra beam bottoms and posts. On the other hand, if the building is small in area and high, two sets of forms may be needed in order to go fast enough.

A long span beam or slab must be supported, in general, a longer time than a short one, chiefly because of the larger dead load. If the dead load, *i. e.*, the weight of the concrete, is heavy in comparison with the live load, *i. e.*, the load which the floor must bear later on, forms must be left a longer time, because the compression in the concrete is large even before the live load comes upon it.

GOVERNMENT STANDARD SPECIFICATIONS FOR PORTLAND CEMENT

IN June, 1911, as noted in past issues of CEMENT AGE, the Secretary of the Department of Commerce and Labor arranged, through the Secretaries of the various departments, for a conference of Government engineers for the purpose of unifying the specifications for Portland cement used by the United States Government. At this conference a committee was appointed to consider existing specifications and to recommend a single specification for Portland cement to be used by all departments of the Government,

After an extended series of meetings of this committee, at which careful consideration was given to representative specifications for Portland cement, as well as to all available data on methods of tests, a tentative specification was developed, which was reported to the departmental conference at a general meeting held July 20, 1911.

In view of the desirability of agreement between the specifications in use by the public and those adopted by the Government, the committee was instructed by the conference to confer with representative consumers and manufacturers as well as the special committees of the national engineering societies more directly interested in the subject of cement specifications. As a result the tentative specifications first reported by the departmental committee were modified slightly, until substantial agreement was reached on practically all points except the methods of determining the normal consistency and time of setting, and the following specifications were unanimously adopted by the departmental conference at the meeting held February 13, 1912.

It was recognized that no specification can be considered final, but must be subject to revision from time to time as occasion requires, and provision will be made for such revision by the various Government departments, all of which have adopted the specification as recommended by the conference.

DEFINITION.—1. The cement shall be the product obtained by finely pulverizing clinker produced by calcining to incipient fusion, an intimate mixture of properly proportioned argillaceous and calcareous substances, with only such additions subsequent to calcining as may be necessary to control certain properties. Such additions shall not exceed 3 per cent, by weight, of the calcined product.

COMPOSITION.—2. In the finished cement, the following limits shall not be exceeded:

	Per cent.
Loss on ignition for 15 minutes......	4
Insoluble residue....................	1
Sulphuric anhydride (SO_3)............	1.75
Magnesia (MgO)......................	4

SPECIFIC GRAVITY.—3. The specific gravity of the cement shall be not less than 3.10. Should the the cement shall be not less than 3.10. Should the cement as received fall below this requirement, a second test may be made upon a sample heated for 30 minutes at a very dull red heat.

FINENESS.—4. Ninety-two per cent of the cement, by weight, shall pass through the No. 100 sieve, and 75 per cent shall pass through the No. 200 sieve.

SOUNDNESS.—5. Pats of neat cement prepared and treated as hereinafter prescribed shall remain firm and hard and show no sign or distortion, checking, cracking, or disintegrating. If the cement fails to meet the prescribed steaming test, the cement may be rejected or the steaming test repeated after seven or more days at the option of the engineer.

TIME OF SETTING.—6. The cement shall not acqire its initial set in less than 45 minutes and must have acquired its final set within 10 hours.

TENSILE STRENGTH.—7. Briquettes made of neat cement, after being kept in moist air for 24 hours and the rest of the time in water, shall develop tensile strength per square inch as follows:

	Pounds
After 7 days..........................	500
After 28 days.........................	600

8. Briquettes made up of 1 part cement and 3 parts standard Ottawa sand, by weight, shall develop tensile strength per square inch as follows:

	Pounds
After 7 days..........................	200
After 28 days.........................	275

9. The average of the tensile strengths developed at each age by the briquettes in any set made from one sample is to be considered the strength of the sample at that age, excluding any results that are manifestly faulty.

10. The average strength of the sand mortar briquettes at 28 days shall show an increase over the average strength at 7 days.

BRAND.—11. Bids for furnishing cement or for doing work in which cement is to be used shall state the brand of cement proposed to be furnished and the mill at which made. The right is reserved to reject any cement which has not established itself as a high-grade Portland cement, and has not been made by the same mill for two years and given satisfaction in use for at least one year under climatic and other conditions at least equal in severity to those of the work proposed.

PACKAGES.—12. The cement shall be delivered in sacks, barrels, or other suitable packages (to be specified by the engineer), and shall be dry and free from lumps. Each package shall be plainly labeled with the name of the brand and of the manufacturer.

13. A sack of cement shall contain 94 pounds net. A barrel shall contain 376 pounds net. Any package that is short weight or broken or that contains damaged cement may be rejected, or accepted as a fractional package, at the option of the engineer.

INSPECTION.—14. The cement shall be tested in accordance with the standard methods hereinafter prescribed. In general the cement will be inspected and tested after delivery, but partial or complete inspection at the mill may be called for in the specifications or contract. Tests may be made to determine the chemical composition, specific gravity, fineness, soundness, time of setting and tensile strength and a cement may be rejected in case it fails to meet any of the specified requirements. An agent of the contractor may be present at the making of the tests or they may be repeated in his presence.

15. In case of the failure of any of the tests, and if the contractor so desires, the engineer may, if he deem it to the interest of the United States, have any or all of the tests made or repeated by the Bureau of Standards, United States Department

of Commerce and Labor, in the manner hereinafter specified, all expenses of such tests to be paid by the contractor. All such tests shall be made on samples furnished by the engineer.

Standard Methods of Testing

SAMPLING.—16. The selection of the samples for testing will be left to the engineer. The number of packages sampled and the quantity to be taken from each package will depend on the importance of the work, the number of tests to be made, and the facilities for making them.

17. The samples should be so taken as to represent fairly the material, and, where conditions permit, at least 1 barrel in every 50 should be sampled. Before tests are made samples shall be passed through a sieve having 20 meshes per linear inch to remove foreign material. Samples shall be tested separately for physical qualities, but for chemical analysis mixed samples may be used. Every sample should be tested for soundness, but the number of tests for other qualities will be left to the discretion of the engineer.

CHEMICAL ANALYSIS.—18. The method to be followed for the analysis of cement shall be that proposed by the Committee on Uniformity in the Analysis of Materials for the Portland Cement Industry, reported in the Journal of the Society for Chemical Industry, volume 21, page 12, 1902, and published in Engineering News, volume 50, page 60, 1903, and in the Engineering Record, volume 48, page 49, 1903.

19. The insoluble residue shall be determined on a 1-gram sample, which is digested on the steam bath in hydrochloric acid of approximately 1.035 specific gravity until the cement is dissolved. The residue is filtered, washed with hot water, and the filter-paper contents digested on the steam bath in a 5 per cent solution of sodium carbonate. The residue is then filtered, washed with hot water, then with hot hydrochloric acid, approximately of 1.035 specific gravity, and finally with hot water, then ignited and weighed. The quantity so obtained is the insoluble residue.

DETERMINATION OF SPECIFIC GRAVITY.—20. The determination of specific gravity may be made with a standardized apparatus of Le Chatelier or other equally accurate form. Benzine (62° Baumé naphtha), or kerosene free from water, should be used in making the determination. The cement should be allowed to pass slowly into the liquid of the volumenomentor, taking care that the powder does not adhere to the sides of the graduated tubes above the liquid and that the funnel through which it is introduced does not touch the liquid. The temperature of the liquid in the flask should not vary more than 1° F. during the operation. To this end the flask should be immersed in water. The results of repeated tests should agree with 0.01.

21. If the specific gravity of the cement as received is less than 3.10, a redetermination may be made as follows:

Seventy grams of the cement is placed in a nickel or platinum crucible about 2 inches in diameter and heated for 30 minutes at a temperature between 419° C. and 630° C. After the cement has cooled to atmospheric temperature the specific gravity shall be determined in the same manner as described above. The cement should be heated in a muffle or other suitable furnace, the temperature of which is to be maintained above the melting point of zinc (419° C.) but below the melting point of antimony (630° C.). The maximum temperature can be recognized as a very dull red which is just discernible in the dark.

DETERMINATION OF FINENESS.—22. The No. 100 and No. 200 sieves shall conform to the standard sieve specifications of the Bureau of Standards, Department of Commerce and Labor.

23. The determination of fineness should be made on a 50-gram sample which may be dried at a temperature of 100° C. (212° F.) prior to sifting. The coarsely screened sample should be weighed and placed on the No. 200 sieve, which, with the pan and cover attached should be held in one hand in a slightly inclined position and moved forward and backward in the plane of inclination, at the same time striking the side gently about 200 times per minute against the palm of the other hand on the upstroke. The operation is to be continued until not more than 0.05 gram will pass through in one minute. The residue should be weighed, then placed on the No. 100 sieve, and the operation repeated. The sieves should be thoroughly dry and clean. Determination of fineness may be made by washing the cement through the sieve or by a mechanical sifting device which has been previously standarized with the results obtained by hand sifting on equivalent samples. In case of the failure of the cement to pass the fineness requirements by the washing method or the mechanical device, it shall be tested by hand.

MIXING CEMENT PASTES AND MORTARS.—24. The quantity of cement or cement and sand to be used in the paste or mortar should be expressed in grams and the quantity of water in cubic centimeters. The material should be weighed, placed upon a non-absorbent surface, thoroughly mixed dry if sand be used, and a crater formed in the center, into which the proper percentage of clean water should be poured; the material on the outer edge should be turned into the crater by the aid of a trowel. As soon as the water has been absorbed, the operation should be completed by vigorously mixing with the hands for one minute and a half. During the operation of mixing, the hands should be protected by rubber gloves. The temperature of the room and the mixing water should be maintained as nearly as practicable at 21° C. (70° F.).

DETERMINATION OF NORMAL CONSISTENCY.—25. The normal consistency for neat paste to be used in making briquettes and pats should be determined by the ball method, as follows:

26. A quantity of cement paste should be mixed in the manner above described under Mixing Cement Pastes and Mortars, and quickly formed into a ball above 2 inches in diameter. The ball should then be dropped upon a hard, smooth, and flat surface from a height of 2 feet. The paste is of normal consistency when the ball does not crack and does not flatten more than one-half of its original diameter.

27. Trial pastes should be made with varying percentages of water until the correct consistency is obtained.

28. The percentage of water to be used in mixing mortars for sand briquettes is given by the formula:

$$y = \tfrac{2}{3} \frac{P}{n \times 1} \times K$$

in which y is the percentage of water required for the sand mortar, P is the percentage of water required for neat cement paste of normal consistency, n is the number of parts of sand to one of cement by weight, and K is a constant which for standard Ottawa sand has the value 6.5.

The percentage of water to be used for mortars containing 3 parts standard Ottawa sand, by

weight. to 1 of cement is indicated in the following statement:

Percentage of water for neat cement paste	Percentage of water for 1 to 3 mortars of standard Ottawa sand
18	9.5
19	9.7
20	9.8
21	10.0
22	10.2
23	10.3
24	10.5
25	10.7
26	10.8
27	11.0
28	11.2
29	11.3

DETERMINATION OF SOUNDNESS.—29. Pats of neat cement paste of normal consistency about 3 inches in diameter, one-half inch in thickness at the center, and tapering to a thin edge, should be kept in moist air for a period of 24 hours. One pat should then be kept in air and a second in water, at the ordinary temperature of the laboratory not to vary greatly from 21° C. (70° F.), and both observed at intervals for at least 28 days. A third pat should be exposed to steam at atmospheric pressure above boiling water for 5 hours.

DETERMINATION OF TIME OF SETTING.—30. The time of setting should be determined by the standardized Gilmore needles, as follows: A pat of neat cement paste about 3 inches in diameter and one-half inch in thickness with flat top, mixed at normal consistency should be kept in moist air, at a temperature maintained as nearly as practicable at 21° C. (70° F.). The cement is considered to have acquired its initial set when the pat will bear, without appreciable indentation, a needle one-twelfth of an inch in diameter loaded to weigh one-fourth of a pound. The final set has been acquired when the pat will bear without appreciable indentation, a needle one twenty-fourth of an inch in diameter, loaded to weigh 1 pound. In making the test the needle should be held in a vertical position and applied lightly to the surface of the pat. The pats made for the soundness test may be used to determine the time of setting.

TENSILE TESTS.—31. Tensile tests should be made on an approved machine. The test pieces shall be briquettes of the form recommended by the Committee on Uniform Tests of Cement of the American Society of Civil Engineers, and illustrated in Circular 33 of the Bureau of Standards. The briquettes shall be made of paste or mortar of normal consistency. Immediately after mixing, the paste or mortar should be placeed in the molds, pressed in firmly by the fingers and smoothed off with a trowel without mechanical ramming. The material should be heaped above the mold, and in smoothing off, the trowel should be drawn over the mold in such a manner as to exert a moderate pressure on the material. The molds should be turned over and the operation of heaping and smoothing off repeated. Not less than three briquettes should be made and tested for each sample for each period of test. The neat tests are not considered so important as the sand tests. The briquettes should be broken as soon as they are removed from the water. The load should be applied at the rate of 600 pounds per minute.

STORAGE OF TEST PIECES.—32. During the first 24 hours after molding the test pieces should be kept in air sufficiently moist to prevent them from drying. After 24 hours in moist air the test pieces should be immersed in water. The air and water should be maintained as nearly as practicable at 21° C. (70° F.).

STANDARD SAND.—33. The sand to be used shall be natural sand from Ottawa, Ill., screened to pass a No. 20 sieve and retained on a No. 30 sieve.

34. Sand having passed the No. 20 sieve shall be considered standard when not more than 2 grams pass the No. 30 sieve after one minute continuous sifting of a 200-gram sample.

35. The No. 20 and No. 30 sieves shall conform to the standard sieve specifications of the Bureau of Standards, Department of Commerce and Labor.

II. Methods of Chemical Analysis

PREFATORY NOTE.—While it may not be necessary to follow the standard method of analysis in routine tests when only a general indication of composition is desired, this method, including all precautions as stated in footnotes and italicized text, must always be followed when the results are to be used as the basis for rejection, or when an accurate knowledge of composition is desired.

The standard method can only yield accurate results in the hands of a careful and experienced analyst when all precautions are properly observed and even under these conditions the results obtained in the determinations of magnesia (MgO), sulphuric anhydride (SO_3), "loss on ignition" and "insoluble residue" may be $\pm$ 0.10 per cent in error, while in general results reported for magnesia tend to be too high. Under less favorable conditions the errors may be of much greater magnitude.

It is desired to emphasize these points so as to prevent rejection of material if the specified limits are exceeded by less than 0.10 per cent.

Chemical Analysis

Method suggested for the analysis of limestones, raw mixtures, and Portland cement by the Committee on Uniformity in Technical Analysis with the advice of W. F. Hillebrand.

Report of Sub-committee (New York Section Society of Chemical Industry) on Uniformity in Analysis of Materials for the Portland Cement Industry.

(All matter printed in italics, both in text and footnotes, has been added during the preparation of this circular at the suggestion and with the approval of W. F. Hillebrand, with special application to the analysis of Portland cement.)

SOLUTION.—One-half gram[2] of the finely powdered substance is to be weighed out and, if a limestone or unburned mixture, strongly ignited in a covered platinum crucible over a strong blast for 15 minutes, or longer if the blast is not powerful enough to effect complete conversion to a cement in this time. It is then transferred to an evaporating dish, preferably of platinum for the sake of celerity in evaporation, moistened with enough water to prevent lumping, 5 to 10 cc of strong HCl added and digested with the aid of gentle heat and agitation until solution is completed. Solution may be aided by light pressure with the flattened end of a glass rod.[3] The solution is then evaporated to dryness, as far as this may be possible on the bath.

[1]The original method was reported in the Journal of the Society for Chemical Industry, vol. 21, p. 30, but the method was subsequently modified by the committee and the above text practically conforms to that in the Engineering Record, vol. 48, p. 49; Engineering News, vol. 50, p. 60.

[2]*If a limestone, 0.75 gram should be used, the approximate equipment of 0.5 gram of cement.*

[3]If anything remains undecomposed it should be separated, fused with a little Na_2CO_3, dissolved and added to the original solution. Of course a small amount of separated nongelatinous silica is not to be mistaken for undecomposed matter.

SILICA (SiO_2).—The residue without further heating is treated at first with 5 to 10 cc of strong HCl, which is then diluted to half strength or less, or upon the residue may be poured at once a larger volume of acid of half strength. The dish is then covered and digestion allowed to go on for 10 minutes on the bath, after which the solution is filtered and the separated silica washed thoroughly with water. The filtrate is again evaporated to dryness, the residue without further heating taken up with acid and water and the small amount of silica it contains separated on another filter paper. The papers containing the residue are transferred wet to a weighed platinum crucible, dried, ignited first over a Bunsen burner until the carbon of the filter is completely consumed, and finally over the blast for 15 minutes and checked by a further blasting for 10 minutes or to constant weight.

The silica, if great accuracy is desired, is treated in the crucible with about 10 cc of HF and 4 drops[4] H_2SO_4 and evaporated over a low flame to complete dryness. The small residue is finally blasted for a minute or two, cooled, and weighed. The difference between this weight and the weight previously obtained gives the amount of silica.[5]

ALUMINA AND IRON (Al_2O_3 AND Fe_2O_3).—The filtrate, about 250 cc from the second evaporation for SiO_2, is made alkaline with NH_4OH after adding HCl, if need be, to insure a total of 10 to 15 cc strong acid,[6] and boiled to expel excess of NH_3, or until there is but a faint odor of it, and the precipitated iron and aluminum hydroxides, after settling, are washed once by decantation and slightly on the filter. Setting aside the filtrate, the precipitate is dissolved in hot dilute HCl, the solution passing into the beaker in which the precipitation was made. The aluminum and iron are then reprecipitated by NH_4OH,[6] boiled and the second precipitate collected and washed on the filter used in the first instance. The filter paper with the precipitate is then placed in a weighed platinum crucible (the one containing the residue from the silica if this was corrected by hydrofluoric acid treatment), the paper burned off, and the precipitate ignited and finally blasted 5 minutes, with care to prevent reduction, cooled and weighed as $Al_2O_3 + Fe_2O_3$.[7]

IRON (Fe_2O_3).—The combined iron and aluminum oxides are fused in a platinum crucible at a very low temperature with about 3 to 4 grams of $KHSO_4$, or, better, $NaHSO_4$,[8] the melt taken up with so much dilute H_2SO_4 that there shall be no less than 5 grams absolute acid and enough water to effect solution on heating. The solution is then evaporated and eventually heated till acid fumes come off copiously. After cooling and redissolving in water the small amount of silica is filtered out, weighed and corrected by HF and H_2SO_4.[9] The filtrate is reduced by zinc, or preferably by hydrogen sulphide, boiling out the excess of the latter afterwards while passing CO_2 through the flask, and titrated with permanganate.[10]

The strength of the permanganate solution should not be greater than 0.0040 g Fe_2O_3 per cc.

LIME (CaO).—To the combined filtrate from the $Al_2O_3 + Fe_2O_3$ precipitate a few drops of NH_4OH are added, and the solution brought to boiling. To the boiling solution 20 cc of a saturated solution of ammonium oxalate is added, and the boiling continued until the precipitated CaC_2O_4 assumes a well-defined granular form. It is then allowed to stand for 20 minutes, or until the precipitate has settled, and then filtered and washed. The precipitate and filter are placed wet in a platinum crucible, and the paper is burned off over a small flame of a Bunsen burner. It is then ignited, redissolved in HCl, and the solution made up to 100 cc with water. Ammonia is added in slight excess, and the liquid is boiled. If a small amount of Al_2O_3 separates this is filtered out, weighed, and the amount added to that found in the first determination, when greater accuracy is desired. The lime is then reprecipitated by ammonium oxalate, allowed to stand until settled, filtered and washed,[11] weighed as oxide after ignition and blasted in a covered crucible to constant weight, or determined with dilute standard permanganate.[12]

MAGNESIA (MgO).—The combined filtrates from the calcium precipitates are acidified with HCl and concentrated on the steam bath to about 150 cc, 10 cc of saturated solution of $Na(NH_4)HPO_4$ is added, and the solution boiled for several minutes. It is then removed from the flame and cooled by placing the beaker in ice water. After cooling, NH_4OH is added, drop by drop, with constant stirring until the crystalline ammonium-magnesium orthophosphate begins to form, and then in moderate excess, the stirring being continued for several minutes. It is then set aside for several hours in a cool atmosphere and filtered. The precipitate is redissolved in hot dilute HCl, the solution made up to about 100 cc, 1cc of saturated solution of $Na(NH_4)HPO_4$ added, and ammonia, drop by drop, with constant stirring until the precipitate is again formed as described and the ammonia is in moderate excess. It is then allowed to stand for about 2 hours,[13] when it is filtered on a paper or a Gooch crucible, ignited, cooled, and weighed as $Mg_2P_2O_7$.

The pyrophosphate invariably contains calcium which can be determined as follows:

Dissolve the ignited pyrophosphate in a little dilute H_2SO_4 and add enough absolute alcohol to make about 90 to 95 per cent of the final volume. After several hours collect the small and sometimes almost invisible precipitate of calcium sulphate on a small filter and wash it free of phosphoric acid with alcohol. Dry the filter and extract from it the precipitate by a few cubic centimeters of hot water acidulated with HCl. Make this solution alkaline with ammonia, throw in a few crystals of ammonium oxalate and continue heating till a precipitate becomes visible. After an hour filter, wash, and ignite to calcium oxide. Its weight, averaging perhaps 0.5 mg is to be added to that of the lime already found and

[4] *5 cc HF and 2 drops H_2SO_4 are sufficient.*

[5] For ordinary control in the plant laboratory this correction may, perhaps, be neglected; the double evaporation never. *The silica so found does not represent quite all in the material under analysis; a little has passed into the filtrate. Account should be taken of a possible loss in weight of the crucible itself, if the blast is very powerful.*

[6] *And 2 or 3 cc of bromine water. Bromine water is used for the purpose of collecting practically all the manganese here, instead of allowing it to distribute among several different precipitates.*

[7] This precipitate contains TiO_2, P_2O_5, Mn_3O_4.

[8] *Or the corresponding pyrosulphates which are less troublesome and more effective than the acid sulphates.*

[9] This correction of Al_2O_3, Fe_2O_3 for silica should not be made when the HF correction of the main silica has been omitted, unless that silica was obtained by only one evaporation and filtration. After two evaporations and filtrations 1 to 2 mg of SiO_2 are still to be found with the Al_2O_3, Fe_2O_3.

[10] In this way only is the influence of titanium to be avoided and a correct result obtained for iron.

[11] The volume of wash water should not be too large; vide Hillebrand, *United States Geological Survey, Bull. 422*, p. 119.

[12] The accuracy of this method admits of criticism, but its convenience and rapidity demand its insertion.

[13] *A paper filter should always be used if the pyrophosphate is to be corrected for contaminations.*

subtracted as tricalcium phosphate (not pyrophosphate) from that of the magnesium pyrophosphate.

In order to determine approximately the iron and aluminum present the following procedure may be followed:

Evaporate the alcoholic filtrate from the calcium sulphate and heat the residue to destroy separated organic matter. Take the residue up with a little HCl and water and when dissolved add a drop of bromine water. Add ammonia till the magnesia is again precipitated and let stand for an hour. Decant most of the supernatant liquid and add slowly, drop by drop, acetic acid till all fine-grained matter has dissolved. Usually there will remain a little flocculent matter which is likely to consist in greater part or wholly of phosphates of iron and aluminum (and manganese if this last was not removed by bromine and ammonia as in the section on Alumina and Iron Oxides). After ignition the precipitate often shows a reddish color. Unless great care is exercised this separation will lead to erroneous results, either by inclusion of magnesium with the impurities as weghed or by loss of these in consequence of using too much acetic acid.

ALKALIES (K_2O AND NA_2O).—For the determination of the alkalies, the well-known method of Prof. J. Lawrence Smith is to be followed, either with or without the addition of $CaCO_3$ with NH_4CL.

SULPHURIC ANHYDRIDE ACID (SO_3).—One gram of the substance is dissolved in 15 cc (5 cc) of HCl, and 45 cc water, filtered, and the residue washed thoroughly.[14]

The solution is made up to 250 cc in a beaker and boiled. To the boiling solution 10 cc of a saturated solution of $BaCl_2$[15] is added slowly, drop by drop, from a pipette and the boiling continued until the precipitate is well formed, or digestion on the steam bath may be substituted for the boiling. It is then set aside overnight, or for a few hours, filtered, ignited, and weighed as $BaSO_4$.

TOTAL SULPHUR.—One gram of the material is weighed out in a large platinum crucible and fused with Na_2CO_3 and a little KNO_3, being careful to avoid contamination from sulphur in the gases from source of heat. This may be done by fitting the crucible in a hole in an asbestos board.

The melt is treated in the crucible with boiling water and the liquid poured into a tall narrow beaker and more hot water added until the mass is disintegrated. The solution is then filtered. The filtrate contained in a No. 4 beaker is to be acidulated with HCl and made up to 250 cc with distilled water, boiled, the sulphur precipitated as $BaSO_4$ and allowed to stand overnight, or for a few hours.

The following procedure is in accordance with the recommendation of W. F. Hillebrand in United States Geological Survey, Bulletin 422, page 227:

In a platinum crucible mix 1 gram of the sample with one-half gram of sulphur-free sodium carbonate. Place the covered crucible in a hole in an asbestos board that is held in a somewhat inclined position and apply a blast flame upon the crucible below the asbestos for 10 to 15 minutes. Transfer the sintered mass to a beaker and cover with water. Cleanse the crucible with dilute hydrochloric acid and pour the solution into the beaker. Add more acid till decomposition is complete in the cold or on gently warming. Filter, wash with hot water, dilute to 150 to 200 cc, boil, and precipitate with barium chloride.

It should be borne in mind that by neither of the methods given is a barium sulphate obtained that is perfectly pure. Ferric (and if present alkali) sulphate, also barium chloride, contaminate it and it is impossible to correct for them directly. The most convenient way to obtain a correction is by a blank with a solution containing sulphur and the other main constituents of the cement in approximately the amounts and proportions found in the test sample.

LOSS ON IGNITION.—Half a gram of cement is to be weighed out in a (covered) platinum crucible, placed in a hole in an asbestos board so that about three-fifths of the crucible projects below, and blasted 15 minutes, preferably with an inclined flame. The loss by weight, which is checked by a second blasting of 5 minutes, is the loss of ignition.

Recent investigations have shown that large errors in results are often due to the use of impure distilled water and reagents. The analyst should therefore, test his distilled water by evaporation and his reagents by appropriate tests before proceeding with his work.

INSOLUBLE RESIDUE.—*The insoluble residue*[16] *shall be determined on a 1-gram sample which is digested on the steam bath in hydrochloric acid of approximately 1.035 specific gravity until the cement is dissolved. The resdue is filtered, washed with hot water, and the filter paper contents digested on the steam bath in a 5 per cent solution of sodium carbonate. The residue is then filtered, washed with hot water, then with hot hydrochloric acid, approximately of 1.035 specific gravity, and finally with hot water, then ignited and weighed. The quantity so obtained is the insoluble residue.*

III. Interpretation of Results

CHEMICAL.—The composition of normal Portland cement has been the subject of a great deal of investigation and it can be said that the quantities of silica, alumina, oxide of iron, lime, magnesia, and sulphuric anhydride can vary within fairly wide limits without materially affecting the quality of the material.

A normal American Portland cement which meets the standard specifications for soundness, setting time and tensile strength has an approximate composition within the following limits:

	Per cent
Silica	19 to 25
Alumina	5 to 9
Iron oxide	2 to 4
Lime	60 to 64
Magnesia	1 to 4
Sulphur trioxide	1 to 1. 75
Loss on ignition	0. 5 to 3. 00
Insoluble residue	0. 1 to 1. 00

It is also true that a number of cements have been made both here and abroad which have passed all standard physical tests in which these limits have been exceeded in one or more particulars, and it is equally true that a sound and satisfactory cement does not necessarily result from the above composition.

It is probable that further investigation will give a clearer understanding of the constitution of Portland cement, but at present chemical analysis furnishes but little indication of the quality of the material.

Defective cement usually results from imperfect manufacture, not from faulty composition. Cement made from very finely ground material, thoroughly mixed and properly burned, may be perfectly sound when containing more than the usual quantity of lime, while a cement low in line may be entirely unsound due to careless manufacture.

The analysis of a cement will show the uniformity in composition of the product from indi-

[14]Evaporation to dryness is unnecessary unless gelatinous silica should have separated, and should never be performed on a bath heated by gas; vide Hillebrand; *United States Geological Survey Bulletin 422, p. 108.*

[15]*Ten per cent solution is preferable to one that is saturated.*

[16]This determination was not considered by the Committee of the Society of Chemical Industry and is reproduced from paragraph 19 of the United States Government specification for Portland cement.

vidual mills, but will furnish little or no indication of the quality of the material. Occasional analysis should, however, be made for record and to determine the quantity of sulphuric anhydride and magnesia present.

The ground clinker as it comes from the mill is usually quick setting which requires correction. This is usually accomplished by the addition of a small quantity of more or less hydrated calcium sulphate, either gypsum or plaster of Paris. Experience and practice have shown that an addition of 3 per cent or less is sufficient for the purpose.

Three per cent of calcium sulphate ($CaSO_4$) contains about 1.75 per cent sulphuric anhydride (SO_3), and as this has been considered the maximum quantity necessary to control time of set, the specification limits the SO_3 content to 1.75 per cent.

The specification prohibits the addition of any material subsequent to calcination except the 3 per cent of calcium sulphate permitted to regulate time of set. Other additions may be difficult or impossible to detect even by a careful mill inspection during the process of manufacture, but as the normal adulterant would be ground raw material, an excess of "insoluble residue" would reveal the addition of silicious material, and an excess in "loss on ignition" would point to the addition of calcareous material when either is added in sufficient quantity to make the adulteration profitable.

The effect of relatively small quantities of magnesia (MgO) in normal Portland cement, while still under investigation, can be considered harmless. Earlier investigators believed that as magnesia had a slower rate of hydration than lime, the hydration of any free magnesia (MgO) present would occur after the cement had set and cause disintegration.

The effect of magnesia was considered especially injurious when the cement was exposed to the action of sea water. More recent investigation has shown that cement can be made which is perfectly sound under all conditions when containing 5 per cent of magnesia and it has also been found that the lime in Portland cement exposed to sea water is replaced by magnesia.

The maximum limit for magnesia has been set at 4 per cent, as it has been established that this quantity is not injurious and it is high enough to permit the use of the large quantities of raw material available in most sections of the country.

Physical

SPECIFIC GRAVITY.—If the Le Chatelier apparatus is used for the determination of specific gravity, the clean volumenometer flask is filled with benzine free from water (which can be obtained by placing some calcium chloride or caustic lime in the benzine storage jar) to a point on the stem between zero and 1 cubic centimeter. The flask is then placed in a constant temperature bath until volume is constant. The usual method is to introduce 64 grams of cement into the flask, taking care that the powder does not adhere to the tube above the liquid, and to free the cement from air by rolling the flask in an inclined position. The flask is then replaced in the constant temperature bath until a constant volume is recorded.

The specific gravity is obtained from the formula:

$$\text{specific gravity} = \frac{\text{weight of cement in grams}}{\text{displaced volume in cu. cm.}}$$

The specific gravity of a Portland cement is not an indication of its cementing value. It will vary with the constituents of the cement, especially with the content of iron oxide. Thus the white or very light Portland cements, containing only a fraction of a per cent of iron oxide, usually have a comparatively low specific gravity ranging from 3.05 to 3.15, while a cement containing 3 to 4 per cent or more of iron oxide may have a specific gravity of 3.20 or even higher. It is materially affected by the temperature and duration of burning the cement, the hard-burned cement having the higher specific gravity. A comparatively low specific gravity does not necessarily indicate that a cement is underburned or adulterated, as large percentages of raw materials could be added to a cement with a normally high specific gravity before the gravity would be reduced below 3.10.

If a Portland cement fresh from the mill normally has a comparatively low specific gravity, upon aging it may absorb sufficient moisture and carbon dioxide to reduce the gravity below 3.10. It has been found that this does not appreciably affect the cementing value of the material; in fact, many cements are unsound until they have been aged. Thus a redetermination is permitted upon a sample heated to a temperature sufficient to drive off any moisture which might be absorbed by the cement subsequent to manufacturing, but would not drive off any carbon dioxide nor correct underburning in the process of manufacturing the cement.

The value of the specific gravity determination lies in the fact that it is easily made in the field or laboratory, and when the normal specific gravity of the cement is known, any considerable variation in quality due to underburning or the addition of foreign materials may be detected.

FINENESS.—Only the extremely fine powder of cement called flour possesses appreciable cementing qualities and the coarser particles are practically inert. No sieve is fine enough to determine the flour in a cement, nor is there any other means of accurately and practically measuring the flour. Some cements grind easier than others, thus, although a larger percentage of one cement may pass the 200-mesh sieve than another, the former may have a smaller percentage of actual flour due to the difference in the hardness and the character of the clinker, and the method used in grinding. Thus the cementing value of different cements can not be compared directly upon their apparent fineness through a 200-mesh sieve. With cement from the same mill, with similar clinker and grinding machinery, however, it is probable that the greater the percentage which passes the 200-mesh sieve the greater the percentage of flour in that particular cement.

NORMAL CONSISTENCY.—The quantity of water used in making the paste from which the pats for soundness, tests of setting, and the briquettes are made, is very important and may vitally affect the results obtained. The determination consists in measuring the quantity of water required to bring a cement to a certain state of plasticity.

In determining the normal consistency by the ball method, after mixing the paste it should be formed into a ball with as little working as possible and a new batch of cement should be mixed for each trial paste. In order to obtain just the requisite quantity of paste to form a ball 2 inches in diameter, a measure made from a pipe with a 2-inch inside diameter cut 1 1/3 inches long will be found convenient. The section of pipe should be open at both ends, so that it can be pushed down onto the paste on the mixing table and the excess paste cut off with the trowel. The appearance of

the ball using the correct percentage of water for normal consistency as compared with a less and greater quantity of water is shown in Fig. 1.

MIXING.—The homogeneity of the cement paste is dependent upon the thoroughness of the mixing, and this may have considerable influence upon the time of setting and the strength of the briquettes.

SOUNDNESS.—The purpose of this test is to detect those qualities in a cement which tend to destroy the strength and durability. Unsoundness is usually manifested by a change in volume which causes cracking, swelling, or disintegration. If the pat is not properly made, or if it is placed where it will be subject to any drying during the first 24 hours, it may develop what are known as shrinkage cracks, which are not an indication of unsoundness and should not be confused with disintegration cracks, as shown in Figs. 2 and 3. No shrinkage cracks should develop after the first 24 or 48 hours. The failure of the pats to remain on the glass nor the cracking of the glass to which the pat is attached does not necessarily indicate unsoundness. In molding the pats, the cement paste should first be flattened on the glass and the pat formed by drawing the trowel from the outer edge toward the center, as shown in Fig. 4.

TIME OF SETTING.—The purpose of this test is to determine the time which elapses from the moment water is added until the paste ceases to be plastic and the time required for it to obtain a certain degree of hardness. The determination of the "initial set" or when plasticity ceases is the more important, as a disturbance of the material after this time may cause a loss of strength and thus it is important that the mixing and molding or the incorporating of the material into the work be accomplished within this time. The time of setting is usually determined upon one of the pats which is to be used for the soundness test, the top surface being flattened somewhat, as shown in Fig. 5. In using the Gillmore needles care should be taken to apply the needles in a vertical position and perpendicular to the surface of the pat. Fig. 6 shows an arrangement for mounting the Gillmore needles so that they are always perpendicular to the surface of the pat. The rate of setting and hardening may be materially affected by slight changes in temperature. The percentage of water used in gauging and the humidity of the moist closet in which the test pieces are stored may also affect the setting somewhat.

TENSILE TESTS.—Consistent results can only be obtained by exercising great care in molding and testing the briquettes. The correct method of filling the mold is shown in Figs 7 and 8. In testing, the sides of the briquette and the clips should be thoroughly cleaned and free from grains of sand or dirt which would prevent a good bearing, and the briquette should be carefully centered in the clips to avoid cross strains. It may be considered good laboratory practice if the individual briquettes of any set do not show a greater variation from the mean value than 8 per cent for sand mixtures and 12 per cent for neat mixtures.

IV. Auxiliary Specifications

BUREAU OF STANDARD SIEVE SPECIFICATIONS.—Wire cloth for standard sieves for cement and sand shall be woven (not twilled) from brass, bronze, or other suitable wire, and mounted on the frames without distortion.

The sieve frames shall be circular, about 20 centimeters (7.87 inches) in diameter, 6 centimeters (2.36 inches) high, and provided with a pan about 5 centimeters (1.97 inches) deep and a cover.

NO. 100 CEMENT SIEVE, 0.0055-INCH OPENING.—The No. 100 sieve should have 100 wires per inch and shall conform to the following specifications of diameter of wire and size of mesh:

The diameter of the wires in the sieve should be 0.0045 inch and the average diameter of such wires as may be measured shall not be outside the limits 0.0042 to 0.0048 inch for either warp or shoot wires. The number of warp wires per whole inch, as measured at any point of the sieve, shall not be outside the limits 98 to 101 per inch, and of the shoot wires 96 to 102 per inch. For any interval of 0.25 to 0.50 inch in which the mesh may be measured the mesh shall not be outside the limits 95 to 101 wires per inch for the warp wires and 93 to 103 wires per inch for the shoot wires.

NO. 200 CEMENT SIEVE, 0.0029-INCH OPENING.—The No. 200 sieve should have 200 wires per inch and shall conform to the following specifications of diameter of wire and size of mesh.

The diameter of the wires in the sieve should be 0.0021 inch, and the average diameter of such wires as may be measured shall not be outside the limits 0.0019 to 0.0023 inch for either warp or shoot wires. The number of warp wires per whole inch, as measured at any point of the sieve, shall not be outside the limits 195 to 202 per inch, and of the shoot wires 192 to 204 per inch. For any interval of 0.25 to 0.50 inch in which the mesh may be measured the mesh shall not be outside the limits 192 to 203 wires per inch for the warp wires and 190 to 205 wires per inch for the shoot wires.

NO. 29 SAND SIEVE, 0.0335-INCH OPENING.—No. 20 sieves shall have between 19.5 and 20.5 wires per whole inch of the warp wires and between 19 and 21 wires per inch of the shoot wires. The diameter of the wire should be 0.0165-inch and the average as measured shall not vary outside the limits 0.0160 to 0.0170-inch.

NO. 30 SAND SIEVE, 0.0223-INCH OPENING.—No. 30 sieves shall have between 29.5 and 30.5 wires per whole inch of the warp wires and between 28.5 and 31.5 wires per whole inch of the shoot wires. The diameter of the wire should be 0.0110-inch and the average as measured shall not vary outside the limits 0.0105 to 0.0115-inch.

Bureau of Standards Specifications for Specific-Gravity Flasks

MATERIAL AND ANNEALING.—The material from which the flasks are made shall be glass of the best quality, transparent, and free from striae. It shall adequately resist chemical action and have small thermal hysteresis. The flasks shall be thoroughly annealed at 400° C. to 500°C. for 24 hours and allowed to cool slowly before graduating. They shall be of sufficient thickness to insure reasonable resistance to breakage.

DESIGN.—The cross section of the flask shall be circular and the shape and dimensions shall conform to the diagram shown in Fig. 9. This design is intended to insure complete drainage of the flask on empting and stability of standing on a level surface, as well as accuracy and precision of reading. The neck of the flask shall be cylindrical for at least 1 centimeter above and below every graduation mark. There shall be a space of at least 1 centimeter between the highest graduation mark and the lowest point of the grinding for the glass stopper.

CAPACITY.—The flask should contain approximately 250 cc when filled to the zero graduation mark.

GRADUATIONS.—The neck shall be graduated from 0 to 1 cc and from 18 cc to 24 cc into 0.1-cc

divisions. The 0.1-cc graduations should be continued two below the 0 and two above the 1-cc graduation. The graduations shall be of uniform width, finely but distinctly etched, and shall be perpendicular to the axis of the flask. The 0.1-cc graduations shall be at least 1 millimeter apart. This will require an internal diameter of the neck not greater than 11.3 millimeters. The 1-cc graduations shall extend completely around the neck of the flask and shall be numbered to indicate the capacity. The 0.1-cc graduations shall extend at least halfway around the neck and the 0.5-cc graduations shall have a length about midway between the other two. The graduation marks shall have no apparent irregularities of spacing.

STANDARD TEMPERATURE.—The flasks shall be standard at 20°C. The indicated specific gravities will then be at 20° referred to water at 4° as unity—that is, density at 20° in grams per cc.

INSCRIPTIONS.—Each flask shall bear a permanent identification number and the stopper shall bear the same number. The standard temperature shall be indicated and the unit of capacity shall be shown by the letters "cc" placed above the highest graduation mark.

TOLERANCE.—The error of any indicated capacity shall not be greater than 0.05 cc.

INTERPRETATION OF SPECIFICATION.—The foregoing specification is intended to represent the most desirable form of specific-gravity flask for use in testing cements. Variations of a few millimeters in such dimensions as total height of flask, diameter of base, etc., are to be expected and will not be considered sufficient cause for rejection. The specification in regard to tolerance, inscriptions, length, spacing, and uniformity of graduations will, however, be rigidly enforced.

The specification is accompanied by the following Executive Order:

It is hereby ordered that all Portland cement that may hereafter be purchased by any Department, Bureau, Office, or independent establishment of the Government, or that may be used in construction work connected with any of the aforesaid branches of the Government service, shall conform in every respect to the specification for Portland cement adopted by the Departmental Conference at the meeting held at the Bureau of Standards on February 13, 1912, and approved by the heads of the several departments (to be known as the United States Government Specification for Portland Cement): Provided, however, that such specification may be modified from time to time by any similar Departmental conference, with the approval of the heads of the several departments.

WM. H. TAFT.

The White House,
April 30, 1912.

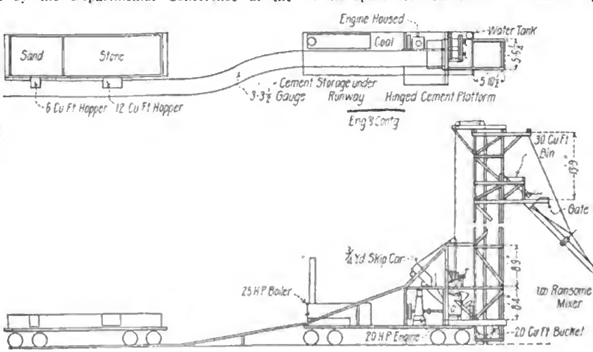
PORTABLE CONCRETE PLANT

[*From Engineering and Contracting.*]

The Florida East Coast Railway is using a concrete mixing plant in constructing abutments, retaining walls, culverts, etc., along its right of way. The plant has been found very economical, mixing 288 cu. yds. of concrete in nine hours with a ¾ cu. yd. Ransome mixer driven by a 20 h.p. engine, the additional power being required to operate the hoist and the ¾ cu. yd. skip car. Steam is furnished by a 20 h.p. boiler.

The sand and stone are received on flat cars to the side of which are attached quick unloading chutes, thus permitting the work of unloading to go on without the necessity of keeping the skip car from taking its load of material to the mixer. The skip car runs on an industrial track that extends up an incline to the mixer. The section of the track between the end of the mixer car and the ground is hinged so that it can be quickly swung up when it is necessary to move the plant and two or three sections of the track can readily be picked up and thrown on the flat car. The skip car discharges into the fixed batch hopper of the mixer, which in turn discharges the finished concrete into a 20 cu. ft. bucket, located in a wooden hoisting tower. The concrete is raised in the tower to a 30 cu. ft. concrete hopper fitted with a radial gate. From here the concrete enters the swinging chute and runs to the point desired.

The plant is portable, the flat car having mounted on it the boiler, engine, mixer, and tower, while space for coal and water tank is provided.



PLAN AND ELEVATION OF PORTABLE MIXING PLANT.

CEMENT GRINDING

By L. H. Sturtevant*

INCREASED competition in the cement business is causing the manufacturer to use every endeavor to reduce the cost of manufacture. Naturally one of the first matters to receive his attention is the grinding machinery. As this forms such an important part of a cement plant, in fact, often determines a profit or a loss to the whole business, it deserves most intelligent investigation.

Five important elements enter into the cost of grinding cement materials:

1. Cost of grinding machinery.
2. Power to operate.
3. Wear and tear (up-keep.)
4. Production (output.)
5. Continuous operation (absence of shut-downs.)

In other words the cost of producing finished cement per barrel per hour in the grinding mills, covers all of these items and the cheapest method of producing this result is the aim of every cement manufacturer.

Large units have come to stay, for the cement business is one of large proportions. The use of many small individual machines is becoming obsolete, and rightly so, for who will install ten small grinders when two large ones will do the work?

It is acknowledged by experienced cement engineers that with any of the small machines now in use it requires from 6 to 10 H. P. per hour per barrel to reduce Portland cement clinker to a finish; that the wear and tear is from $800 to $1,800 per year per grinding mill (tube mills excepted.)

The above figures are only for clinker. The cost of grinding limestone, coal, shale and clay, while not so great for upkeep, in the matter of power is practically the same. If a large unit can produce the same results with one-half the power and at one-half the cost for upkeep, one can readily appreciate the reason for its adoption.

Working toward this end the Sturtevant cement unit has been developed, and placed on the market. This unit lessens materially the cost of his finished product, thus making large savings in all of his grinding departments, and also lessens labor and cheapens buildings, because of the small space occupied for large outputs. Thus it simplifies and unifies the entire plant. This unit consists of a "Giant Duplex Ring Roll Mill," an elevator, two "Newago" separators and one tube mill.

The "Giant Ring Roll" is used in combination with a tube mill for two reasons:

First. Because we believe no single machine can do two kinds of work with equal efficiency; i. e., it is either better as a preliminary grinder than as a finisher, or vice versa.

No mill having internal screens can be as efficient as a mill that is free to grind and discharge its finished product the instant it is made.

It has proved a physical impossibility to make internal screens of sufficient size or give them proper vibration to handle the product of any good grinder. The result is that much of the sufficiently ground material cannot escape, which cushions and thus cripples the grinding action of the machine, lowering its efficiency and causing much useless wear and tear and bearing trouble due to excessive confined dust.

By removing screens from ball and other mills tests have proved the mill efficiency was increased by as much as 33 1/3 per cent.

*The Sturtevant Mill Co., Boston.

The "Ring Roll" can be used as a finishing mill, but we would rather use it in just the place for which it is best adapted, as a preliminary grinder. On 20 mesh grinding, taking clinker 1½ in. size, its output is from 80 to 130 barrels per hour. On 40 mesh work, 60 to 80 barrels. On 80 mesh grinding 40 to 60 barrels per hour. All of this is accomplished with 80 H. P.

Although we do not build tube mills and have no interest whatever in them, we recommend them as finishers, because the tube mill *properly used* is just as ideal as a finisher as the "Ring Roll" is as a preparatory grinder.

Properly used the tube mill is a big unit with no small parts to give trouble, and it is a continuous operator.

Even the power is in its favor instead of against it. Grinding with a 20 mesh feed it does unquestionably take too much power for its output; i. e., 75 H. P. is needed to drive a 5 x 22 mill to get from it only 12 to 15 barrels per hour. (H.P.per barrel per hour approximately 7 H. P.)

But take that same 75 H. P. and feed the tube with 40 *mesh* clinker and note the results: 30 *barrels per hour* instead of 12 to 15 barrels as before (H P. per barrel per hour approximately 7 H. P.)

Now again, take the same mill, same power, and give it an 80 mesh feed. The results will be a revelation. It now produces from 40 *to 55 barrels* per hour. (H. P. per barrel per hour approximately 1¼ H. P.)

Let us see next what can be expected from a unit, properly arranged, on a scientific basis, where screens are used, but in their proper place, and each machine operated in a highly specialized manner, never allowing either to do anything except just *that work for which its proved adaptability cannot be questioned.*

SUGGESTED PLANT.

1. No. 2 Duplex "Ring Roll" Mill. Taking 1½ in. to 2 in. clinker and grinding to 80 mesh. Capacity 40 to 60 barrels per hour. Power 80 to 90 H. P.
2. No 3 "Newago" Screens. To take out the 80 mesh material from the "Ring Roll" product. Comparatively coarse screening and 100 sq. ft. of efficiently vibrated 40 mesh wire cloth to do the work. Power 1 H. P. each.
1. 6 x 18 Tube Mill. To take the screened 80 mesh ground clinker from the "Ring Roll" and "Newago" Screens and reducing it to a finish, 98 per cent. 100 and 85 per cent. 200 mesh. Capacity 40 to 60 barrels per hour. Power 75 to 85 H. P.

Thus we have a unit 900 to 1,500 barrels output per day, with a power expenditure of approximately 3½ H. P. per barrel per hour.

This is the largest unit of its type and yet is as accessible and as elastic as any plant of small *individual* machines which is full of complications, and a complete machine shop is necessary to keep it going.

The above unit has been criticised by some engineers on the ground that it is too big, too unwieldly. They say if something goes wrong the whole plant is shut down.

Let us see if this is true.

The "Ring Roll" mill of Duplex design has each half absolutely independent of the other—one half may be operated while the other half is at rest or is stopped for repairs. This feature enables the

operator to reduce the workable size of the unit by half. The mechanical arrangement of this mill is well known. The ring and three roll shells are *thick* and hard and last a long time, because the ring runs at only 64 R. P. M. and the rolls have exactly the same surface speed, and when they need replacements it is the work of only *minutes* instead of hours to "open the door" and put new rolls on.

The elevator and two "Newago" screens are next considered. An elevator is necessary in any case usually *several*, plus conveyor systems that are needed for a multitude of small units; therefore one elevator for a single great producer is not a complication.

"Newago" screens are continuous runners, for while the small parts of one screen wear out, yet duplicate parts may be easily and cheaply kept on hand so there is no delay in the whole system or stoppage while necessary changes are made in one screen. This is a comparatively *coarse screening system* and is therefore easy, for the separators have a great capacity on coarse work, and the large wire used for coarse screening renders them *durable*.

The tube mill is the only machine left, and is too well known to require description. Its interior parts consist of linings, replaceable once a season, and pebbles which may be replenished at intervals through the manhole.

Shut-downs are expensive for a cement plant, particularly that ought to be relied on to operate continuously. This point is appreciated by every manufacturer. The Sturtevant unit should be a continuous runner.

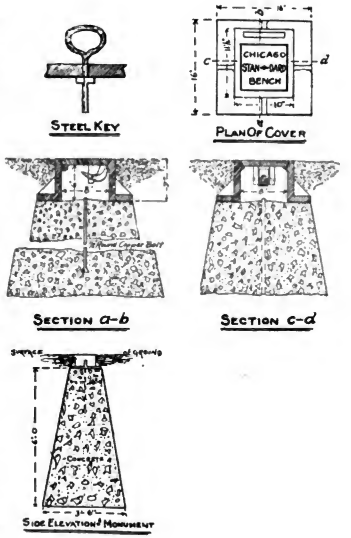
Such a unit apparently presents many advantages. In up-keep, housing required, power required, in short in grinding cost per barrel of production, a large unit has radical inherent advantages. It is the traction gang-plow, or the mowing machine displacing the hand plow and the sickle. Such a development is in accord with the times, and promises much for the cement manufacturing field.

Concrete Bench Marks in Chicago

The Division of Street Grades and Benches in Chicago sets and maintains for its use bench marks throughout the city, and has for several years been running a system of exact levels, previously constructing standard bench monuments where these are required. During 1910, 24 bench monuments were constructed and standardized, bringing the total number of these concrete standard monuments to 175, located at an average distance apart of one mile east and west and north and south. In addition there are 15 monuments whose exact elevations have not yet been determined. Thirteen more will complete the system which is laid out for the entire city. The monuments built last year cost $25 each, by contract, to which should be added the cost of the iron covers, copper rods and lumber forms which are furnished by the city, and which bring the total cost to the city to $30.07 per monument.

In addition to these standard monuments there have been located ordinary bench marks on such objects as brick buildings, nails in the roots of trees and, when nothing better was found, on curb stones catch basins and fire hydrants, 1,784 of these having been established while running the lines of precise levels. The most reliable of these are believed to be those on buildings in the "loop district" that rest on concrete caissons extending down to the rock foundation.

As shown by the accompanying sketch, the standard bench monuments are of concrete, set with the base 6 ft. 6 in. below the ground surface. The monument is a truncated square pyramid 3 ft. 6 in. on a side at the base and 16 in. square at the top, the height of the concrete being 6 ft. In the top of this is set, vertically a ½-in. round copper bolt, upset at the lower end to hold it firmly in place. On top of the concrete rests a cast-iron head 8 in. square in the clear inside, the bottom provided with a 4-in. flange all around. This is covered with an iron cover which is locked in place, a simple steel key being required for releasing the cover.—*Municipal Journal.*



STANDARD CONSTRUCTION FOR BENCHES AND MONUMENTS IN CHICAGO.

The number of times that forms are used in building construction generally depends upon the size and height of the building, which limits the number of times to use, rather than on the actual wear upon the forms. In other words, forms are not generally worn out when discarded, and frequently the same lumber can be used in two large buildings, provided the two are substantially alike in design, although of course with a greater labor cost.

CONSISTENCY AND TIME IN MIXING CONCRETE

By H. F. Porter*

THE preparation of concrete is an art, and as such requires painstaking attention to every detail, from the selection of suitable materials to their final deposition in the molds in form for the finished structure.

By no means the least important of the steps is the operation of mixing, wherein the materials for the first time are brought together and by thorough agitation worked into a homogeneous plastic mass.

It goes without gainsay, that the mixing must be thorough and complete, in order to achive satisfactory results. Indifferent or incomplete mixing will no more turn out good concrete, than scanty stirring good cake dough. The operation must continue until, sensibly, the inert and solid particles, fine as well as coarse, are thoroughly coated with the cement cream, and themselves occupy the most intimate relationship one to another possible.

The proper degree of mixing may be gauged simply by the appearance. It is an indication that the operation has continued long enough when the mass assumes a uniform color and a dense, smooth appearance, or, in other words, becomes thick and gruelly.

The amount of water used in mixing, evidently, is of prime importance. This must be adjusted so that the mass on completion of the operation is just the proper consistency. To gauge it to a nicety and keep it right, requires the utmost care and vigilance. This detail, therefore, should be entrusted only to a workman of acuteness and unquestioned reliability.

The value of a good man thoroughly trained to this task, is hard to overestimate. Not only does he become an expert judge of the degree of mixing and the proper consistency, but of the correctness of the proportions. The barometer is not a more accurate gauge of atmospheric conditions, than he of the quality of concrete. Let him once know what good concrete is—concrete correctly proportioned, thoroughly mixed, and of proper consistency—and he will never again be deceived by a "make-believe" or "good-enough."

The question of the proper amount of water has already been discussed, but at the risk of repeating some points it will again be taken up. Regardless of theoretical requirements, there should be enough water to thoroughly lubricate the mass, such that when done and ready to place it should be soft enough to flow, but not so soft as to separate.

If there is too much water, the mass will lack coherency, tend to separate; if too little, it will be dry and crumply. Both extremes are bad, but the latter is rather worse, at least from a practical standpoint, than the former. In fact a slight excess is sometimes desirable, and on a practical basis justifiable, for the reason that it facilitates the mixing and placing, the imbedment of steel, and the securance of a smooth surface finish. On the other hand, too dry a mixture not only is more difficult, therefore more expensive, to mix and place, but, in the case of reinforced concrete, lacks the elements essential to a thorough union of the two materials. Not only that, it is deficient in strength and density, and is far more liable to disintegrating influences. Too wet a mixture is also deficient in strength and density, although not in the same degree as too dry; it is the lesser of two evils.

Quoting from Bulletin 344, of the U. S. Geological Survey: "The tests lead to the belief that the tensile and compressive strength are alike affected by both age and consistency. . . . The effect on the strength of the variation in consistency is clearly shown. *In almost every case the concrete of the damp consistency is the strongest and that of the wet consistency the weakest.** . . . Attention is called to the fact that the damp consistency used was much wetter than that used in making mortar building blocks, for which the same conclusions may not apply.

"The effect of the consistency on the strength seems to depend to a great extent on the behavior of the concrete while being tamped and to the method used in tamping. Great care was taken to tamp all the concretes in the same manner.

"*The thorough mixing of the concrete is absolutely essential and has a marked influence on the consistency.*

"While it is true that in almost every instance the drier mixtures give the greater strength, it does not follow that dry (or damp) mixtures should be used in construction. Practical considerations warrant the use of a wet mixture. The difficulty in securing efficient tamping and a smooth finish in a damp concrete, the loss of strength due to the unavoidable drying out of the concrete used above water, the difficulty of securing in reinforced concrete an intimate union with the steel, and the far greater ease of placing wet concrete all seem to warrant the sacrifice of what in many cases is but a slight difference in strength for a greater ease of manipulation and a thorough bedding of the steel, which is of the utmost importance in reinforced concrete work."

The concurrence of the foregoing conclusions

[Under Consultation item 176, this question was discussed in *Concrete Engineering* some time ago. At the 1910 convention of the National Association of Cement Users, President Humphrey urged that concrete be mixed for a longer period, and that a more definite consistency should be used. The problem merits careful attention.—EDITORS.]

*Bridgeport, Conn.

with the foregoing remarks is obvious, chiefly as follows:

1. The strength is affected directly and considerably by the consistency; and

2. The consistency is markedly affected by the thoroughness of the mixing.

The utmost care must be taken to see that these requirements are met. * * * *

There is another very practical way of testing the consistency. It should be such that the concrete will flow through a chute or closed channel freely and yet without separating. If too dry it will be found to clog up the channel, to pile up on the chute and if it moves at all to crumble and roll in parts. If too wet it will be found to separate. These are facts of prime importance, and have a vital bearing on the economics of concrete construction. There is little question but that, eventually, concrete will be distributed entirely in this manner, making use of the principle of flow of liquids. It is thus that Thomas Edison proposes to cast houses in one operation of pouring. Moreover, the practicability and economy of this method for ordinary construction has already been demonstrated, in the case of the Christian Science church in Los Angeles, California, completed in 1909, which is entirely of concrete, the material having been placed in the molds by means of a flexible pipe system operating from a central tower. Not only were marked economies hereby effected, but a far more homogeneous concrete, of greater strength and more uniform appearance, was secured. It was found on this job that the mixing must be thorough and the consistency proper, else the concrete would not work properly; if too dry it would clog the pipe; if too wet, it would separate; only when just right would it flow through the pipe easily. Considerable time was saved in placing, which made possible the handling of the material without running the risk of premature induration. Thus, in every way, maximum efficiency was found to be coincident with maximum economy.

As to the value of thorough mixing, data quoted from the Watertown Arsenal Report for 1911, page 154, under the caption—"Effect of Mechanical Agitation and Regaging," are pertinent. Continuous agitation of the mix for two hours is seen to have increased the strength nearly 20 per cent. over the strength after the first few minutes of mixing, such as is ordinarily considered adequate. Further continuation, however, of the operation is seen to have been attended by a progressive falling off in strength. The inference is, that the mixing, while it needs be thorough, at the same time must be expedited as much as possible, in order not to encroach upon the periods of crystallization. While the effects of continuous agitation is, undoubtedly, to postpone the setting, nevertheless there must ensue a period when the setting can not longer be delayed without injury to the product. Thus there is the danger of *over-mixing*, as well as *under-mixing*. Of course, there is little likelihood of this extreme occurring in practice, unless exceptionably, by accident. On the contrary, the likelihood is almost entirely the other way: the great difficulty with all concrete work is to have the mixing done thoroughly enough, the temptation is strong to make haste at the expense of the thoroughness of mixing. Still, over-mixing is a contingency with which, on occasion, to reckon. Such is the situation, when, perforce of unexpected circumstances, the charge in a concrete mixer cannot be taken away and distributed for a considerable length of time. The question is—How long may a batch of materials continue to be revolved in a machine without suffering serious loss of strength?

The writer once had an experience which bears directly upon this point. It so happened on a certain job that the noon hour found the concrete mixer charged, and the foreman, instead of working a few minutes overtime in order to dispose of the charge, allowed it to remain, but kept the machinery going. The writer, arriving on the scene shortly afterwards, while the men were at lunch, discovered the condition of affairs and promptly forbade the use of this batch. Contrary to his instructions, however, while he was on another part of the work, it was hoisted to the floor, and he returned to the spot just in time to intercept it. He ordered it cast aside upon a portion of the floor placed some days before and already fairly hard. He supposed that it had been ruined by the protracted agitation. Much was his surprise, therefore, and the foreman's delight, to find the discarded concrete flint-hard the next day, and adhering so tightly to the floor slab as to require painstaking picking to remove. Moreover, it was the smoothest and densest appearing concrete, and the most uniform in color and texture, of any concrete he had seen in practice. His one regret was that a sample had not been secured for a strength test. This was several years ago. Since then examples and experiments have multiplied to corroborate the writer's observations, and to establish the wisdom of much more thorough mixing than has, in times past, been the practice.

Perhaps the most valuable data bearing on this point—as to the effect on the strength of thoroughness of mixing, aside from the report of the Watertown Arsenal previously quoted—is that obtained by C. G. Streels, assistant city engineer, Sioux City, Iowa, which are herewith given:

Results of tests made in 1902, on effect of continuous mixing of Portland cement mortars, by C. G. Streels, assistant city engineer, Sioux City.

Sand through sieve of 20-meshes per lin. inch and retained on sieve with 30-meshes per lin. inch; 99 oz. of cement, 220 oz. of sand and 24 oz. of water, or 7.77 per cent. of the cement and sand.

No. of briquets in lot.	Continuously mixed for Hrs.	Mins.	Tensile Strength per sq. in.
4	0	15	294
2	0	30	278
2	0	45	282
2	1	00	243*
2	1	25	275
2	1	55	283
2	2	25	287*
2	2	55	314
2	3	25	326*
2	3	55	372
2	4	25	334†
2	4	55	384
2	5	25	264
2	6	25	308*
2	7	25	217
2	8	25	255
4	8	55	246
4	8	55	220*
2	8	55	215*

* 2 oz. water added. † 3 oz. water added.

All of the above samples, it will be observed, were mixed much more thoroughly than is the average current practice. A batch that receives more than 5 minutes turning, at the most, is a rare occurrence, and an accident rather than an intention. The series had been of more value, apropos of the present discussion, if results had been obtained for short-time mixings—under 15 minutes, the minimum given in the table. Maximum results are seen to have been obtained between 4 and 5 hours, which is about twice as long as found beneficial in the Watertown tests. This difference, no doubt, is due to the amount of water used in the mixing and the brand of cement. As far as practical indications are concerned, however, the two observations are in accord: both emphasize the necessity for thorough mixing. The time element involved is immaterial. The fact remains that the mixing must be done properly, whether it takes 5 minutes or 5 hours, and if a machine is available that will do the work in 1 minute, so much the better.

Tensile Tests of Concrete Using Large Specimens

IN the engineering laboratory of Cornell, tests were recently made on concrete specimens measuring 6 x 6 x 18 in. These were reported by Prof. A. P. Mills in a recent issue of the *Cornell Civil Engineer*:

The specimens tested were of three different mixtures. The first was a 1:2:4 mixture containing limestone crushed to pass a 1½-in. ring. The second a 1:2:4 mixture containing cobbles, mostly sandstone, crushed to pass a 2½-in. ring. The third was a 1:2½:5 mixture using crushed sandstone similar to that of the second mixture.

Special attention was given to the design of the grips, since earlier tests of large specimens have indicated a tendency to crush or shear off in the jaws before actual failure in tension occurs. The device adopted was designed with a view to eliminating the danger of failure under complex stress instead of under direct tensile stress.

Each grip consists of a solid cast-steel envelope having the form of a hollow truncated pyramid of square section. The sides of this envelope were machined inside and out to a slope of 1 in 10, the smallest interior diameter being 7 in. the largest 8 in., and the length of the envelope 5 in. Wedges were made of hard maple and, in order to permit them to slide with little friction upon the envelope, they were shod on the outside and ends with steel, machined smooth. The use of four wedges permitted the specimen to be gripped alike on all four sides; ⅝-in. steel bolts, placed at the corners, connect the envelope to a cross-shaped bearing-plate of cast-steel which transmitted the stress to a 1½-in. steel bar which was in turn gripped by the jaws of the testing machine. The connection of this steel bar to the bearing-plate was a spherical bearing, so that there was no possibility of the stress being applied in any manner except along the central axis of the apparatus and specimen. Care was taken in every case to drive wedges in to an equal degree of pressure before applying the load.

The results attained by this device, it is stated, were very satisfactory in every way. The majority of the specimens broke well away from the grips at some point within the 3 to 4-in. space between the grips. In no case, even when failure occurred close to the grips, was there the least indication of any crushing between the wedge grips. The break was always perfectly clean, there being absolutely no loose particles, and the fracture was usually in a plane practically at right angles to the direction of application of the load.

In many instances, in the tests of the sandstone concrete, stones were split in two in the plane of the fracture instead of breaking the bond with the mortar; this was particularly true in the case of the red sandstone.

The 1:2:4 limestone concrete in six tests shows an average tensile strength of 278 lb. per sq. in., the highest being 308 lb. per sq. in., and the lowest 253 lb. per sq. in.

The 1:2:4 sandstone concrete in nine tests shows an average tensile strength of 150 lb. per sq. in., the highest being 178 lb. per sq. in., and the lowest 128 lb. per sq. in.

The 1:2½:5 sandstone concrete in nine tests shows an average tensile strength of 129 lb. per sq. in., the highest being 179 lb. per sq. in., and the lowest being 97 lb. per sq. in.

Compression tests were also made of these mixtures and from the data thus obtained certain comparisons have been made. The tensile strength is in the neighborhood of 10 per cent of the compressive strength, being 11.1 per cent for the 1:2:4 limestone concrete, 9.3 per cent for the 1:2:4 sandstone concrete and 8.8 per cent for the 1:2½:5 sandstone concrete. Comparing the sandstone concrete with the limestone concrete, while the 1:2:4 sandstone concrete has 64.6 per cent of the strength of the limestone concrete of the same mix in compression, it has only 54 per cent of the strength of the limestone concrete in tension. The second-class sandstone concrete has 58.8 per cent of the strength of the first-class limestone in compression, but only 46.4 per cent of the strength of the limestone concrete in tension.

A COMPARISON OF SEVEN BUILDING CODE REQUIREMENTS FOR THE DESIGN OF REINFORCED CONCRETE*

Jerome Cochran, M. C. E., '07

A COMPARISON with regard to the stipulations concerning reinforced concrete design in the following building regulations, *i. e.*, St. Louis, 1909; San Francisco, Jan., 1910; Joint Committee†, 1909; Borough of Manhattan (New York City), before 1907; National Association of Cement Users, 1910; Chicago, 1910; and Cleveland, 1909, disclose the fact that marked variations occur even among those most lately and most carefully prepared. So many new experimental and analytical investigations are constantly being reported that changes are to be expected and certainly should be made from time to time, if we are to keep up with the best practice of today.

Certain sections of the seven building codes or regulations above referred to are of such a general nature that practically no changes are required in the compilation that has been prepared (See tabulation of building code requirements accompanying this article) or in any revision to be made by the parties offering them. For example, such parts as those concerning cement, sand, aggregates, water, placing of steel reinforcement, removal of forms, depositing concrete and the like, have become fairly well standardized. For this reason, these parts have been omitted from the table, leaving the requirements to be considered as affecting design only.

UNIT STRESSES: The permissible unit stresses in the reinforcement are found to vary somewhat in the different codes, varying from 14,000 to 20,000 lb., (12,000 to 18,000 for the Old Code of Louisville, Ky.), although a 16,000 lb. limit holds in the Joint Committee regulations and the Borough of Manhattan, while an 18,000 lb. limit holds in Chicago. (The National Fire Protection Association allows one-fourth of the ultimate strength, while the Royal Institute of British Architects limits are 15,000 to 17,000). Where a 20,000 lb. limit has been established for high carbon material the apparent influence of the manufacturers of that special material have affected a reduction in the permissible stress for mild steel so that its working unit stress is reduced to 11,000 lb., for examples, in the St. Louis building code. A majority of the building codes have limited steel in shear to 10,000 lb., although Chicago allows 12,000 lb.

Compared with the allowable unit stress for steel however, the permissible unit stresses for other factors are found to vary widely. The extreme bending stress for concrete runs from 800 lb. for St. Louis (Cincinnati allows from 800 for 1:1½; 3 concrete to 600 for 1:2½; 5 concrete) through 750, 700, 650 and down to 500 lb. for San Francisco and the Borough of Manhattan, while the allowable stress in direct compression varies even more widely and erratically from 700 lb. for San Francisco (Borough of Brooklyn allows 750 lb.) through 650, 500, 450, and down to as low as 350 lb. for the Borough of Manhattan for the so-called 1:2:4 concrete.

Similarly, the unit stresses for adhesion and shear combined with diagonal tension are erratic in the extreme, varying from 25 lb. for St. Louis to 120 lb. for the Joint Committee regulations. The Joint Committee recommended that beams be reinforced against diagonal tension when the shear exceeds a limit of 2 per cent of the compressive strength at 28 days or 40 lb. 2,000 lb. concrete. The unit stresses for the adhesion of concrete to steel alone are also erratic in the extreme, varying from 50 lb. for the Borough of Manhattan, through 65, 70, 80 and up to 150 lb. for the Standard Building Regulations of the National Association of Cement Users.

Again, turning to the subject of the ratio of the moduli of elasticity between steel and concrete, it may be stated that with the exception of the Borough of Manhattan, the same ratio is employed, *i. e.* 15. The National Fire Protection Association, however, allows 18, while Boston (1907) requires that 10 be used for columns. For practical design it is recommended that the ratio of the modulus of elasticity of steel to that of concrete be taken at 15, corresponding to a concrete modulus of 2,000,000.

COLUMN DESIGN: The rules for column design are even more erratic, St. Louis allowing 14,000 lb. unit stress in the vertical steel. With one or two exceptions, the other codes have failed to mention what maximum stress would be allowed in the vertical reinforcement of the columns. There appears to be no limit as to the pitch of spiral hooping allowed in the St. Louis code, the minimum being one-tenth of the diameter of the core while Chicago allows one-tenth of the diameter of the core as a maximum. There is a variation in the requirements for spacing horizontal hooping from 12 to 20 times the least diameter of the reinforcing bars, regardless of the size of columns. Cleveland allows only 12 inches as the maximum spacing for horizontal hooping. Rules for column design either with horizontal or spiral hooping has been entirely dodged by the Borough of Manhattan and Cleveland. The other five codes have treated the subject more or less fully, the only complete one being Chicago. In the rules formulated in the majority Report of the Joint Committee, little or no difference is made in the allowance for the safe and unsafe types of column reinforcement. This should be otherwise, for the recommendations of this Committee represent the most satisfactory rules thus far formulated and because of their general acceptance as a standard.

The maximum unit stress allowed on columns by the majority of building codes are too high for for safety in plain concrete, concrete reinforced with vertical steel and with a small number of horizontal hoops, and about half as high as should be for the better types of reinforcement such as the proper percentage of vertical steel combined with spiral hooping.

As the matter now stands, it is an open question with the designing engineer or architect as to just what will be allowed in the design of reinforced concrete columns. In the light of present knowledge of the design of reinforced concrete columns, borne out by practical tests, there is no excuse for building codes to misrepresent or to omit such important information. Extensive study and investigation have led to the addition of simple working formulae and practical recommendations which make possible a complete treatment of column design.

*In the "Cornell Civil Engineer" for November, 1911.

†The Joint Committee is composed of members selected from the American Society of Civil Engineers, The American Society for Testing Materials, the American Railway Engineering and Maintenance of Way Association, and the Association of American Portland Cement Manufacturers. This committee represents the highest authority in the United States and its recommendations have tended to standardize general practice.

BENDING MOMENTS: The permissible bending moments for the design of beams, girders and slabs are found to vary somewhat in the different codes, varying from $WL/12$ for the majority, through $WL/10$ for Cleveland and up to $WL/8$ for the Borough of Manhattan, for continuous beams and girders. Probably the reason why the Borough of Manhattan requires that beams and girders be figured for a bending moment equivalent to that of a simply supported beam, is to provide for earthquake shocks.

The value of $WL/12$ for the bending moment has been widely adopted in Continental Europe, is being used in general practice in Germany and is recommended in the 1907 French rules. The more conservative value of $WL/10$ has been stipulated by many of the building laws in the United States in order to provide for the possibility of poor construction or unforseen conditions, for when using $WL/12$ it is absolutely necessary that the beam or girder be really continuous both in design and construction and that stresses due to negative bending moment at the support be provided for.

Four of the codes require that end beams be figured as simply supported, while the Joint Committee, National Association of Cement Users and Chicago allow the bending moment to be figured as $WL/10$, which appears to the writer to be amply safe.

There is a much closer agreement among the codes considered concerning the moment for continuous slabs, five of the codes allowing $WL/12$, the other two requiring $WL/10$. A majority of the codes make no statement as to the permissible bending moments in end slabs. It is customary to figure end slabs with a bending moment of $WL/10$ as allowed by Chicago. Some of the codes do not appreciate the added safety involved in two-way slab reinforcement as compared with one-way reinforcement.

None of the building codes considered or for that matter any others state what should be the bending moment in a square reinforced concrete foundation slab loaded at the center and reinforced equally in two directions. In fact, the literature of the subject is meager and evasive and disagree in assumptions and results. It is customary for some practitioners to consider such a footing the reciprocal of a slab supported at two opposite edges, figure $M = \frac{1}{2} P \times \frac{1}{4} (a - b) = \frac{1}{8} P (a - b)$. Others, considering it the reciprocal of a square slab supported at its four edges, figure $M = \frac{1}{4} P \times \frac{1}{4} (a - b) = \frac{1}{16} P (a - b)$. Still others, considering it a cantilever in four directions, figure $M = \frac{1}{4} P \times 1/3 (a - b) = 1/12 P (a - b)$. Where P = total load to be carried by the footing, a = width of footing and b = width of column.

Just because a footing is out of sight is no reason why it should be out of mind. In other words, as much attention should be given to its design as to the rest of the structure, for according to the above three assumptions, some designers put in twice as much reinforcements as others. It does not appear to be out of place for building codes to state what should be the permissible bending moment in a square reinforced footing slab.

WIDTH OF FLANGE OF T-BEAMS: The width of slab to use for the flange of T-beams in compression has evidently been selected arbitrarily as will be apparent from a study of the accompanying table. In no case of course can it be taken greater than the distance between beams. The Joint Committee has recommended a width not exceeding one-fourth the span length of the beam (one-sixth the span length is required by the National Association of Cement Users and one-third the span of beam by the Royal Institute of British Architects), while Cincinnati (May 1909) allows beams to be figured the full slab and has limited the width to use on either side of the web to four times the thickness of the slab. It is probably safe to use a somewhat greater ratio of width to thickness than this in many cases. The National Association of Cement Users permit six times the thickness of slab each side of beam (Cincinnati allows the same for girders, while Detroit allows only three times the thickness of slab each side of the beam or girder).

MISCELLANEOUS DETAILS: Little or no mention is made in the different codes regarding reinforced concrete curtain walls. There appears to be no reason why building codes should not mention such an important subject. The tendency on the part of many designers is to leave out much of the steel that is required to prevent shrinkage cracks. Less than half of the codes considered require a loading test after completion. The item appears to the writer to be too important to be thus overlooked.

RECOMMENDATIONS FOR STANDARDIZATION: It may be pleaded that practice has not yet become sufficiently well defined to admit a closer agreement among code requirements, but from a careful study of the subject and from the fact that a majority of the codes referred to were promulgated in 1909 and 1910, it would seem that there still remained room for a vast amount of experiment, comparative analysis and unification of requirements. The widest publicity should, therefore, be given to the subject of proposed building code requirements, both those of municipalities and those proposed by such bodies as the Joint Committee and the National Association of Cement Users, because codes in the larger cities and of such bodies are apt to be made models on which the codes of the smaller communities are based.

The average municipality calls in those who have had little, if any, experience in actual construction of reinforced concrete to frame its rules and regulations. The result is that the designer and constructor in reinforced concrete are expected to submit tamely to the regulations drawn up by men ignorant of the first principles of their business and yet, they are expected to work under the handicap of competition by men who will comply literally with these rules and put up the cheapest and most dangerous type of work that badly drawn rules will permit. This is a deplorable state of affairs and it is about time that municipalities wake up to the fact that those actively engaged in the business are best qualified to draw up safe and sane rules for construction and employ such men to formulate their building code requirements, instead of going outside of those familiar with the art.

Precision of statement with regard to every possible point wherein danger may possibly result from poor design or fabrication, combined with conservative, but not immoderate restricted stress stipulated, is the ideal to be sought in promulgating future building codes.

No attempt has been made to consider all the different building codes in this country, for most of them are similar to one of the seven selected. For those who wish to make a further study of building code requirements they are referred to a tabulated list of some twenty odd building codes in the Proceedings of the National Association of Cement Users, Vol. 6, Feb., 1910.

BUILDING CODE REQUIREMENTS FOR REINFORCED CONCRETE.

Requirements Considered			St. Louis	San Francisco	Joint Committee	Natl. Assoc. Cem.	Chicago, Ill.	Manhattan	Cleveland, O.
			Dec. 1909	1910 (Jan.)	1909	Users 1910	June 1910	Before 1907	Sept. 1909
Concrete fc		Bending	800	500	650	650	700	500	700
		Bending over Support			750	750			
		Shear (Direct)	175		120				
		Diagonal Tension	25	75	40 to 120 Note 3	40 Max. Spac. ½ Depth	40	50	50
Adhesion of Concrete to Steel			65 Note 1	60 to 100	80	80 to 150	70 to 100	50	
Ratio of Moduli of Elasticity			15	15	15	15	15 Note 4	12	15
Steel fs		Tension	14,000 to 20,000	⅓ E.L.—20,000	16,000	16,000 to 20,000	18,000	16,000	16,000 to 20,000
		Shear		10,000	10,000	10,000	12,000	10,000	10,000
Columns	Horizontal Hooping	Concrete in direct compression	500	500	450	450	400 Note 4	350	500
		Vertical Steel " "		7,500		6750	Note 5		10,000
		% Vertical Steel	1% Minimum	1% to 5%			Min. ½% or 1 sq. in. Max. 3%		1% to 10%
		Hor Hooping	.03 Sq. in Cross-Sec. Min.	.05 Sq. In.					
		Spacing of Hoops	20 x least diam. rod				12 x at least diam. of rod	Least width of Col.	
		" " " Max.		Diam. of Col.			18 ins.		12 ins.
	Spiral Hooping	Concrete in direct compression	500	750	650	650	500 Note 6	Note 8	
		Vertical Steel " "	14,000	7500		9750	Note 5	"	
		% Vertical Steel		1% to 5%	1% to 4%	1% to 4%	½% to 8%	"	
		Spiral Hooping	Special rule Note 2						
		% of Spiral Hooping			Min. 1% Volume of Core	1%	½% to 1½%		
		Pitch of " "	Min. 1/6 diam. Core.	1/6 diam. core	¼ diam. Core	⅙ diam. core	Max 1/6 diam. core		
		" " " Max.					" 3 inches		
		Minimum Cross-Section		10 inches diam.			64 Sq. in.		
		Ratio of Height to Least Diam.	15	15	15	15	12	12	12
		Insulation	2 ins.	2 ins.	2 ins.	2 ins.	1½ ins.		2 ins.
Beams and Girders	Moment	Interior	WL/12	WL/12	WL/12	WL/12	WL/12	WL/8	WL/10
		End	WL/8	WL/8	WL/10	WL/10	WL/10	WL/8	WL/8
		Width of T Beam	¼ Span Max.	5 x Depth of Slab	¼ Span (4 x depth of slab each side—Max.)	¼ span or 6 times thickness of slab each side	⅓ span or ¾ C-C Beams	10 x width of beam	⅔ span of slab
		Steel over Supports for Continuity	Full negative bending moment	No cracks und. 2 cal. loads Min. 75% area met at cen.			WL/18		50% Amt of Center
		Spacing Steel	2" clear	1½ diam. clear	Min 2½ dia. cts Min. side to c. 2 diam Min. Vert ½"		1½ diam. clear		
		Insulation	1½ ins.	2 ins.	1½ ins.	1½ ins.	1½ ins.		1½ ins.
Slabs	Moment	Interior	WL/12	WL/12	WL/12	WL/12	WL/12	WL/10	WL/10
		End					WL/10		WL/8
		Supported on Four Sides		WL/20		WL/12 each way	WL/24 Int. WL/20 End	WL/20	
		Minimum Thickness		3" Roof. 3½ ins. Floor				3½ ins.	4 ins.
		Insulation	1 in.	¾ in.	1 in.	1 in.	½ inch		¾ in.
		% Steel		⅓ of 1% area concrete Max. 2½ ins. cts.		Min. ¼% Max. 18" cts.	Note 7		
Walls		Minimum Thickness		6 ins.		4 ins	8 ins		
		Insulation		1 in.					
Deflection allowed on load test				Twice load [illegible] deflection			Twice load [illegible] deflect	3 x load no sign of failure	3 x L.L. no sign of failure

Note 1 (St. Louis). The maximum allowable working stresses for deformed bars shall be 1/6 of the ultimate force required to pull such bars of 6 in. embodiment in concrete.

Note 2 (St. Louis). For spiral hooping: The compression resistance which would be produced by imaginary longitudinals, stressed the same as the actual longitudinals, the volume of the imaginary longitudinals being taken at two and four-tenths times the volume of the hooping.

Note 3. (Joint Committee). The following allowable values for the maximum shearing stress are recommended:

(a) For beams with horizontal bars only 40 lb. per sq. in.

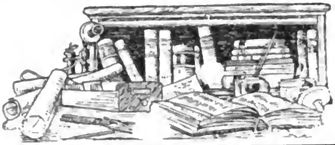
(b) For beams in which a part of the horizontal reinforcement is used in the form of bent-up bars, arranged with due respect to the shearing stress, a higher value may be allowed, but not exceeding 60 lb. per sq. in.

(c) For beams thoroughly reinforced for shear a value not exceeding 120 lb. per sq. in.

Direct compression in concrete shall be one-fifth of its ultimate strength to be in accordance with the following table:

Mixture	Ratio of Moduli.	Ult. Com.
1:1:2	10	2900
1:1½:3	12	2400
1:2:4	15	2000
1:2½:5	18	1750
1:3:6	20	1500

Note 5 (Chicago). The compressive stress in steel shall not exceed the product of the compressive stress in the concrete multiplied by the elastic modulus of the steel and divided by the elastic modulus of the concrete.



CONSULTATION

218. Solid or Open Spandrel Arch Construction

"In considering alternate bridge designs submitted, we are interested in further information on the comparative value of solid or open spandrel construction."

Discussion by B. H. Davis
Consulting Engineer, New York City

I looked up Mr. Louten's article* discussing the merits of solid and open spandrel arch bridges and it seems to me that in a discussion of a subject of this kind, some mention should have been made by Mr. Luten regarding the reduction of dead load possible through the use of spandrel arches, which correspondingly cheapen the foundation cost where a spread footing is to be made.

Another thing that he might have mentioned, I think, would have been the simplicity of the waterproofing problem in the case of a slab floor supported by bench walls or columns and girders. The height of the structure far more than its span should determine whether or not spandrel arches or solid spandrel retaining wallls should be used. High spandrel arches are often used over very short spans where vertical headroom is excessive.

Discussion by H. Gratton Tyrrell
Consulting Bridge Engineer, Evanston, Ill.

A decided tendency is evident toward the greater use of ribbed arches in preference to those with solid filling, the reason being chiefly due to their less cost.

Concrete arches may be divided into three general classes:

(A). Those with the floor or pavement supported on solid earth filling over the arches.

(B). Those in which the floor is supported by a system of beams and columns bearing on a solid arch ring, the side spandrels being either open or enclosed with light curtain walls.

(C). Those in which all framing is exposed, and the floor supports and arches made of individual members with outlines similar to arches in wood and steel.

Arches with solid filling (Class A) have the advantage of less cost of forms, but they are open to numerous objections, some of which are as follows:

The solid filling prodeces heavy loads which require thicker arch ring and larger foundations. Their stress condition is also uncertain, especially in reference to the conjugate horizontal thrusts of the filling in the haunches. The action of the side retaining or other longitudinal walls is indefinite, for unless provided with expansion joints, they may exert considerable arch action. And if the longitudinal walls are without expansion joints, cracks will probably form at the base of these walls just above the arch. To prevent such cracks, longitudinal walls have frequently been clamped to the arch ring, but this only adds complexity to stress conditions which are already indefinite. Expansion joints in side walls when provided, are usually placed 25 to 50 feet apart and a lap or tongue is the best as it permits longitudinal movement and still holds the sections in position. The side retaining walls may be either of the gravity type, with base thickness 40 per cent, of their height, or they may be thin reinforced concrete walls with counterforts inside. Another serious objection to arches with solid filling is that unless the laying of the pavement is deferred for a long time, it is liable to settle, even when the filling has been rammed and flooded in the most approved manner. Water also collects in the filling, and not only increases the load but discolors the face wall and soffit where it leaks through.

Both types with open spandrels (B and C) have the advantage of lighter arch weight with a corresponding saving in the cost of the foundation. In one case of a three span bridge with openings of 140 ft. and 30 ft. rise, the open spandrels caused a decreased load on the foundations of six tons per pile. Type B is illustrated by Piney Creek bridge at Washington, one of the finest in America. The bridge has twin arch rings and a reinforced concrete slab floor supported on a system of interior concrete beams and columns which are enclosed from view by light side curtain walls. The great arch of 328 feet over the Tiber at Rome has similar curtain walls enclosing hollow spandrel chambers. Both of these designs are insincere in that hollow chambers appear on the exterior to be solid, but the enclosing walls are economical in that the interior framing may be left in a more or less rough condition, which if open would require finer treatment.

Comparing the three types, there seems to be little reason for using Class A excepting for short spans of 50 ft. or less, with small rise, for in this case the cost of floor slab and spandrel framing may easily be greater than solid filling and pavement Type B is more economical in most cases than A, and should generally be carried out with open transverse arcades or colonades, as this type is more truthful than one enclosed. The decreased cost of foundations is, in most cases, enough reason for giving it preference over class A. Large spans, and especially those with lofty roadways, are much cheaper in ribbed arches of Class C, the footways projecting out beyond the supporting arch ribs.

*March, 1912.

224. Cost of Concrete Walls

"I quote from page 204 of your November issue: 'Rough hollow blocks may be had of almost any particular shape from machines in use in almost any cement block factory, and are the cheapest form in which concrete can be built into walls of any height'.

"Blocks are one kind of unit wall construction. Are they the cheapest?"

DISCUSSION BY WILLIAM DRUMMOND**

I would say in this connection that my statement was meant to fit conditions that obtain widely. There are plenty of cement block factories which could supply satisfactorily a list of blocks of specified size and shape, and plenty of masons to be had to lay them up, in all towns throughout the country and I know that the "metal foreman," even were he available, could not produce the artistic effect attendant upon the use of rough-surface cast blocks colored in the stack when green. The repulsiveness of the cloudy, patchy, smeary, characterless poured concrete surface is a curse no inexpensive form construction can overcome. So I hold that for the few men interested here and there in artistic and inexpensive effects this method should yield satisfactory results as compared with the use of brick or stone ashlar.

Mr. Drummond is the author of the statement quoted in the question, and his opinion of the availability of block construction is of especial interest in connection with previous discussions of this question.—EDITORS.

175. Oiling Forms

"Is there available at the present time any good data on methods and costs of oiling forms? What I am particularly interested in is in securing 'experience data' on whether or not it 'pays' to oil forms, life of lumber, appearance of concrete, etc. 'Does it pay'?"

175. DISCUSSION BY THOS. BROWN*

In reference to the use of oil on forms, my experience is that to obtain the best results from concrete mold oils, the timber must be coated several days before it is required for concrete purposes. This gives it time to get dried into the timber. It should also be heated to make it thinner, and it then goes further upon the timber surface.

I have known pile shuttering to have been treated with oil in what I call its raw state (without having been heated.) The consequence was that the oil got into the concrete and prevented it from setting, with the result that the oil got the blame and the bad name, instead of the men who put it on.

The experience I have had on various contracts with mold oils has proved that by heating two gallons of oil in a bucket, which would cover 93 sq. yds., the approximate cost (labor only) was about 1/16d. (1/8 ct.) per sq. yd. The total cost, including labor and oil, was about 5/16d. (5/8 cts.) per sq. yd.

Mold oils preserve timber when it is coated on both sides, and also add a smooth surface to the concrete. In fact, I have seen concrete after the timber has been stripped, with a glassy surface, all through the result of being properly treated.

In my opinion, mold oil *does pay* when properly looked after and treated.

**Architect, Chicago, Ill.

*Secretary The Yorkshire Hennebique Contracting Co., Ltd., Leeds, England.

198. Paper or Cloth Sacks for Cement?

"In current practice are the best results obtained by buying cement in cloth sacks, or in paper sacks? Cloth are preferable for handling, and mean less wasted cement, but the loss in empty bags, and the trouble in sending them back are drawbacks. What information is available on this question?"

198. DISCUSSION BY E. B. ALLEN*

The correct answer to the above question is at the present time a much mooted question among the users of Portland cement. Probably the time will never come when either form of package is entirely eliminated. I believe, however, that as time goes on, and the buyers of cement analyze more and more carefully the merits of this question, the use of paper packages will steadily increase. Perhaps the best method of bringing out the disadvantages of the cloth package, as compared to the paper package, is by means of a hypothetical case.

Let us assume the price of bulk cement to be $1.40 per bbl.

"A" buys 1,000 bbls. packed in cloth and is invoiced at $1.80 per bbl., or $1,800. Of his invoice $400 covers the cloth bags purchased at 10 cts. each from the cement manufacturer. It is part of the purchase contract that the cement company agree to buy back this $400 worth of bags for $400 provided they are *all returned* to the cement company's mill in *good condition*. The purchaser who does not carefully analyze the question therefore concludes that his cement cost is only $1,400 plus the item of freight in returning the bags.

"B" purchases 1,000 bbls. of cement in paper bags and is charged $1.50 per bbl. for same: $1.40 being for bulk cement and 10 cts. for paper packages. His invoice is therefore $1,500.

At first glance and before analyzing the question it would appear that "A" had acquired 1,000 bbls. of cement for $100 less than "B," a difference of 10 cts. per bbl. "B," however, who possesses an analytical mind reasons to himself that he is better off than "A" for the following reasons:

1. "A" has an intem of expense for prepaying freight on the bags he returns. "B" has none.
2. "A" has the time and labor expense of collecting, counting, storing, keeping tally, packing, cartage, etc., of the cloth bags, which item is one of large proportions. "B" has none of this trouble or expense.
3. The cloth bags purchased by "A" require time to untie and time and care to empty thor-

*From "Concrete Costs," by Taylor and Thompson.

oughly. "B's" paper sacks require little time to untie, can be handled easily, cut with a hoe, broken across a box or barrel and emptied instantly.

4. "A" sustains a loss of cement in transit, estimated at one lb. per sack of 4 lb. in a barrel, sifting through the bag in handling. "B" sustains no loss through sifting. He runs the risk of a possible loss in tearing, but the present good grade of Manila rope paper sacks turned out by the established bag manufacturers reduces this risk to a minimum. The quality of paper turned out to-day is better than any heretofore produced.

5. "A" sustains a loss in emptying his cloth bags. Laborers are often so careless as to leave from .5 to 1.5 per cent. adhering to the sides of the bags.* "B's" paper sacks empty easily; no sticking of cement to sides.

6. "A" is almost sure to suffer loss through theft and carelessness. A cotton sack is an attractive article to laborers. They use them for aprons, tool bags, clothes for the family and they are handy to have around the house for other purposes. They are also used to carry coal, brick and stone and every bag so used is damaged or destroyed. "B" suffers no loss through this channel.

7. "A" runs the risk of loss through dampness. Moisture is absorbed by and easily penetrates the cloth bag, damaging the cement and causing it to stick to the bag. "B" suffers no loss from ordinary dampness, and, in fact, cement in paper bags frequently goes through short rain storms without damaging the cement.

8. "A" suffers a loss of 40 cts. or 2/7 the price of a barrel of bulk cement for every four bags unreturned to the mill. If the bags are not carefully packed several are often lost in transportation; if not properly tagged, whole bundles are often lost. Add to this the number of bags not returned because stolen or not accepted because damaged and this item is surprisingly large. Fifteen to 20 per cent of bags purchased are lost or so damaged as to be worthless for credit. "B" suffers no loss of this character.

9. "A" runs the risk, at least, of a disagreeable dispute with the mill over the sacks he has returned both as to the condition of the bags and the count. Disputes take time and energy and are costly to both parties. Furthermore, the cement mills usually take their estimate of condition and count as final. "B," through the use of paper sacks, obviates this possible disagreeable feature in his business.

10. "A" runs the possible risk of not getting the brand of cement specified. Unscrupulous dealers have been known to pack poor cement in second-hand bags bearing the lable of the brand supposedly purchased. "B" knows positively he is getting the brand he orders.

"A" pays the cement company a profit ranging from 10 per cent. to 40 per cent. on every cloth bag he is obliged to purchase from them at 10 cts. each, since the cement companies purchase the cloth cement sacks at from 7 to 9 cts. each, and their customers buy these bags after they have often had as many as five or six deliveries with them at 10 cts. each.

The buyer of cement, who, like "B," carefully analyzes this problem will, in my opinion, come to the conclusion that a paper package when made of stout, tough paper gives a service which is well worth the apparent higher cost.

"B" estimates that the apparent differential of $100 in favor of cloth on the 1,000 bbl. order herein referred to, is reduced 60 per cent through the item of lost and damaged bags alone. On good authority 15 per cent is a just estimate of the number of bags which are not returned or which are so damaged as to receive no credit. Applying this estimate to "A's" order he will fail to receive credit for 15 per cent. of 4,000 bags, or 600 bags, which he is obliged to buy from the cement company at 10 cts. each or for $60. This reduces the differential on the 1,000 bbl. order to $40. Now, in addition to the tangible cash loss from uncredited cloth bags "A" also sustains a tangible loss of about 2 per cent. from cement sifting through the cloth in transit and from sticking to the inside of the bags when emptied. This item would, therefore, amount to $28, reducing the cash differential in favor of cloth bags to $12.

"B" therefore figures that if the return freight charges, the time and labor of collecting, counting, storing, keeping tally, packing, cartage, etc., of the cloth bags, the lost time in emptying them, the risk of loss through dampness, the risk or a dispute with the cement company supplying the cement and the risk of not getting the brand of cement specified, is worth to him $12 or more, he is a gainer through having purchased his cement in paper bags.

I hope the above opinions will appeal to careful, accurate thinkers as being well founded upon the rock of fact and that they will prove interesting to those of your readers who have not hitherto given this subject the careful, analytical study which it deserves.

[* The experience of the Aberthaw Construction Co. on this point is of interest. Experiments showed that they could make an average of 17½ cts. per one hundred bags of cement used by having them thoroughly shaken before bundling for return shipment and recovering the cement. It was found that it decreased the number of bags a man would bundle about one-third to have him stop long enough to pull the bag over two sticks mouth down and give it a good beating. There was reported on this investigation 7,598 bags. The cost of shaking, bundling, and tagging, being $22.44. As shown above but one-third of this, or $7.48, should be charged as the expense of the cement saved which amounted to 4,130 lbs. This would be .54 lb. per sack, or 56 per cent. It is probable that on the regular run of work this might be as high as 1 per cent, which would reduce the tangible loss of 7 per cent or $70 to 5 per cent or $50.

The 4 per cent may seem high, and probably with more careful handling could be reduced considerably. The floors of cement sheds on construction work, and the ground below the floor after the shed is torn down, generally present an instance of wasted cement.

Further opinions on handling cement will be of interest.—Consultation EDITOR.]

*Cleveland, Ohio.

198. **Rebuttal Discussion by Gordon Wilson***

As stated by Mr. Allen, the correct answer to his question is one on which a great deal may depend. While we cannot altogether agree with him that increased consumption of cement in paper will result from the uninfluenced demand of the consumer, we might, as cement manufacturers, express the hope that such will be the case.

The returnable cloth sack is a source of trouble and expense for every cement manufacturer, involving, as it does, the necessity for maintaining plants and organizations to handle, count, inspect, clean, repair and account for the returned sacks. In assuming this expense the manufacturer has been chiefly influenced by the belief that he was offering his customers the best and most economical package that could be obtained.

In considering Mr. Allen's hypothetical case, we will accept his preliminary assumption and make a few comments on the reasons that he advances from a cloth sack point of view. In the interest of brevity we are simply answering him, point by point, under the numbers that he has given his paragraphs.

1. Cement is one of the cheapest commodities per ton that is manufactured. $5.00 per ton net, f.o.b. mlil, is a pretty fair price for cement nowadays. As a general proposition, any Portland cement made by a reputable manufacturer is a good cement. Therefore, there is no object in paying high premiums for variations in quality. The result is that the marketing of cement is essentially a matter of freight rates and service and the territory of each plant is decidedly limited by the freight rates that apply from competing plants.

This means that cement will not, as a general rule, be shipped very long distances, and consequently that the cloth sacks will not have to travel back very far. The rate on returned empty cement sacks from Minneapolis to Chicago is 12½c. per cwt., and we may assume that this is a fair average; also, that the average weight of a sack is one pound, both of which estimates are liberal. The freight in this case would be an eighth of a cent a sack, or half a cent a barrel. Charge this against the fixed cost of 10 cents per barrel for paper bags and a balance of 9½c. remains in favor of the cloth sacks.

2. This is all granted, but on the other hand, "A" does not have the expense of shoveling up and resacking cement from broken packages in every car that he receives. "A" is not at the mercy of every switchman that handles his car en route, because the cloth sack will withstand a tremendous amount of the abuse in the shape of bumping and jolting that freight cars receive in switching. With regard to the proportions of the sack handling expense to which "A" is subjected, it may be left to the judgment of the individual cement user to say what the labor expense of collecting 4,000 sacks from the job and storing them would be. It has been our observation that the work of counting and packing is done at odd moments by men who would otherwise be unemployed and that the cartage is generally done by a wagon that would otherwise go down to the depot empty for a load of inbound freight.

3. This point can best be answered by observing two jobs; one using cloth and the other paper. Nowadays, most cement sacks are tied with wire, which can be removed by three turns of the wrist and one jerk. We think that it will be found that this can be done in about the same length of time that it would take a man to pick up a hoe. A few vigorous shakes will empty the sack sufficiently for practical purposes and this, we believe, can be done in the same length of time that it would take to pick out the fragments of torn paper from a batch of concrete that was being made by the process of laying the paper bags on top of the sand and then hacking them open.

4. We would like to accept Mr. Allen's estimate that four pounds of cement per barrel were lost in transit through sifting out of cloth sacks, but are hardly prepared to do so. A carload of 170 barrels is less than average size, but if Mr. Allen's figures are correct, the loss through sifting in a car of this size would be 680 pounds We have seen a great many hundreds of carloads of cement unloaded and are prepared to affirm that in very few of them was this much cement left lying on the floor after the unloading was completed. On the other hand, in cleaning up the almost inevitable breakage from paper bags in a carload of cement of this size, there is every chance of an equivalent quantity of cement being lost, either by sifting out of the car while it is in transit, or by becoming so mixed with dirt from the car floor that it is no longer in usable condition.

5. This point has already been approached from another angle under heading No. 3. Under the present heading we would say that the completeness with which a cloth sack or a paper bag is emptied is purely one of personal equation. Mr. Allen appears

Note.—The following quotation from the letter enclosing this discussion is of interest:

"We do not wish it to appear that we are condemning the paper bag as a package for cement; on the contrary, we are very glad to use it whenever and wherever it is possible and, as you can readily appreciate, we, in company with other cement manufacturers would be only too glad to eliminate the bother and expense of returnable packages.

"We cannot consistently say to our customers however, that it is to their advantage to buy cement in paper, because we do not honestly believe that it is. Unquestionably there are certain occasions and circumstances where it is to the customer's advantage to buy in paper, but our argument of course, is based on the average conditions."

We would be glad to have further comment on this question from the users of cement.—Consultation Editor.

to have assumed that "A's" foremen and laborers are not as careful as "B's."

6. If "A" allows the theft of his property, such theft will not be limited to cloth sacks. People will steal his shovels and other tools likewise. We have seen cloth sacks used in all the ways that Mr. Allen describes, but have always regarded this as a defect in the management of the job from which the sacks came, rather than an inherent disadvantage of the sacks. On every job there is likely to be some petty thieving unless steps are taken to prevent it. Belting is stolen and used to make hand shields and half-sole shoes, but surely this is no argument in favor of substituting gear drives for belt drives. While we would be the last to recommend misuse of cloth sacks by employing them to handle other commodities, we must take exception to the fact that every sack so used is destroyed. Cloth sacks are used to handle dry sand, crushed stone and material of that nature without destroying them.

7. This argument again is based on the assumption that "A" is going to be inefficient and careless in handling his materials. No cement user can afford to start on a job without providing facilities for housing his cement and protecting it against the weather. While it is true that cement in paper bags may go through short rains without the cement being damaged, it will be found almost impossible to pick up the water soaked bags without causing them to break.

8. We have never talked with a cement user yet who did not consider it fair and just to assume that the cost of handling empty cloth sacks was easily offset by the spillage and breakage of paper bags. The only loss that "A" is expected to suffer is his proportion of the natural wear and tear of the sacks, plus loss and damage that are the result of his own carelessness. We will give "A" credit having sense enough to bundle and tag his shipments properly. In fact, the railroads now have, incorporated in their tariffs, rules compelling him to do this, and we will assume that "A" will protect his property against theft and damage that is wilful or the result of carelessness. This leaves "A" to stand only the wear and tear on four cloth sacks, plus the return freight to the mill. The wear and tear would have to amount to nearly 25 per cent. in order to offset the flat and irrecoverable charge of 10 per cent. per barrel that comes from the use of paper.

9 This argument would have been an excellent one five years ago. In the last five years however, the educational work done by the cement manufacturers has begun to bear fruit, and disagreeable disputes are the rare exception nowadays rather than the rule. "B," on the other hand, may see fit to make a claim against the company that shipped him his cement for loss resulting from breakage of paper bags. Thereupon he is informed that cement in paper is shipped at the purchaser's risk of breakage and that he must take the consequences.

10. The cement manufacturer cannot guarantee that cement in paper will get to destination without breakage, and for this reason he ships it at the purchaser's risk of breakage. In order to let his customer down as easily as possible, however, he always puts a number of empty paper bags into every car that he ships in order that his cement may be resacked and put into bags bearing his brand. There is nothing to prevent the unscrupulous dealer from filling these extra bags with anything that he may see fit, but before leaving this point, we should go on record as expressing the opinion that very few dealers will resort to any such dishonorable practice. Even assuming that the dealer would be tempted to do this, there would be no money in it for him unless he substituted something that was not Portland cement, and he would certainly be detected if he did.

Mr. Allen states that "A" pays the cement company a profit ranging from 10 per cent. to 40 per cent. on every cloth bag he is obliged to purchase from them at 10 cents each, since the cement companies purchase the cloth cement sacks at from 7 to 9 cents each, and their customers buy these bags after they have often had as many as five or six deliveries with them at 10 cents each. Let us assume that the cement manufacturer buys the sack new for 7 cents and that he makes five deliveries in it. Each time that sack comes back he buys it for 10 cents. During the lifetime of that sack the manufacturer will have paid out a total of 47 cents for it from time to time, and will have received a total of 50 cents for it, leaving a net margin of 3 cents, which has to pay for counting, inspecting and handling the sack four times and also, possibly, for mending it once or twice. As a matter of fact, cloth sacks now cost more than 7 cents each and come back more than five times on the average, but even giving Mr. Allen all the benefit of the doubt, we believe it will be agreed that the profit of the cement manufacturer can safely be ignored in this discussion. If more evidence is required, however, we would call attention to the fact that the cement manufacturer buys paper bags as he needs them so that he does not have to tie up his capital in any more than a current supply. On the other hand, he buys the bulk of his cloth sacks in November and December when he will not need them for maybe three or four months. Each one of these sacks that he carries through the winter represents an investment of 10 cents and a working stock of two million sacks is none too many to be carried over durng this period by a cement plant of average size. Before closing this subject therefore, please deduct from the profits of the cement

manufacturer the interest on $200,000 for four months at, say, 6 per cent.

In closing Mr. Allen proceeds—on a basis of figures that he has worked out—to chop the differential on a thousand barrel order down to $12.00 in favor of cloth, but of which the unfortunate "B" still has to pay a number of charges and take a number of risks, but these figures are based on premises that are not altogether favorable to "B," to say nothing of the cloth sack, and we will not quarrel with him in detail. In closing however, we would like to raise one point. The production of Portland cement in the United States in 1911 was, in round numbers, 80,000,000 barrels or 320,000,000 sacks. Is there enough raw material available to turn out 320,000,000 paper bags per annum, to say nothing of the additional numbers required for future uses in the output of cement without causing a rise in the price of "the present good grade of manilla rope paper" or any "stout, tough paper" strong enough to make a bag that will carry 95 pounds of cement through a trip in a springless and frequently jolted box car and endure the subsequent unloading, piling, rehandling, loading into wagons, hauling over more or less rough roads; unloading, repiling and subsequent rehandling that is the history of the average package of cement. Assuming that the proper grade of paper could still be furnished at a price that would enable the manufacturer to sell the paper bags at 2½ cents each, is there not a tremendous economic waste to be considered? Supposing last year's output had all been shipped in paper, there would have been $8,000,000 worth of paper bags burned up or thrown away to get rid of them. A comparatively small percentage of $8,000,000 is still worth saving to the country, and if the cloth sack offers any means of saving but a part of this, it is discharging an important duty to the country at large, as well as to the individual cement consumers who, through their care and intelligent handling of cloth sacks, reap their proportion of the economies that result from the use of them.

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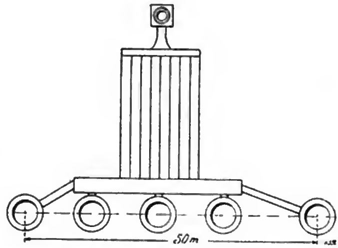
221. Using Waste Heat from Kilns

"In studying the question of cement manufacture, we are interested in the possibilities of using waste heat from two kilns to dry or pre-heat raw material, or to pre-heat water for boilers. What is the present day opinion of this matter?"

221. Discussion

In a recent issue of Tonindustrie-Zeitung, the following comment is noted:

If a number of kilns are connected to one chimney, the waste gases can be used for drying if the arrangement as shown in the illustration is used. Good draft from the chimney is one of the essentials in this arrangement. The chimney for such a plant should be higher than 106 ft. In the figure the



SKETCH SHOWING ARRANGEMENT OF FLUES TO USE WASTE HEAT.

drying chamber lies at right angles to the axis of the collecting channel, and will give excellent results, and very slight heat losses, since the distance from the two end kilns is not great enough for this. The flues in the drying chamber should not be more than 40 cm. (16 in.) in diameter.

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All subscriptions paid in advance will be filled by CONCRETE-CEMENT AGE. In the case of subscribers who are paid in advance for both CEMENT AGE and *Concrete* the expiration date of subscription to CONCRETE-CEMENT AGE will be advanced to correspond with the amount paid to each periodical. The work of consolidating the two subscription lists is now going on, but will naturally take some time. The utmost care will be taken to avoid errors, but should any occur we ask the indulgence of subscribers until they can be adjusted. Any subscriber to CEMENT AGE who does not receive the July issue of CONCRETE-CEMENT AGE should notify the Concrete-Cement Age Publishing Co., Detroit, Mich.

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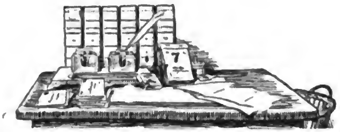


CORRESPONDENCE

The "Control Beam" for Testing Concrete

I have been using the control beam to some extent in laboratory work in concrete. At first for testing I used tanks and ran water into them, applying the load at the center of the beam, but later I have used the method described here and shown by the accompanying cut, and like it much better.

The reaction at one end of the beam is carried through a ⅝ in. iron pipe to a wood block, which transfers it to the platform of a 1,000 lb. scale. The middle of the beam is held at two points equidistant from the center by means of a 4 in. by 4 in. wood beam, which is supported in place by a ⅝ in. gas pipe across its top, at its center and which passes through holes in 2 in. by 4 in. uprights, made of wood and passing down to a 6 in. by 6 in. beam to which they are nailed. This beam forms the base of the machine and supports the scales on one end and a jack on the other. The jack is used to apply the load or reaction at the end of the beam which is not supported on the scales.

After everything is in place and before any load is applied the weight on the scales is taken and this is subtracted from the final reading to obtain the end reaction. This end reaction equals one-half of the load or force applied downward at the center, and divided into two equal parts, which are transferred to the ends of the 4 x 4 beam and applied to the control beam through the pipes.

The load is applied by setting the slide on the scale beam forward 10 lbs. at a time and turning the jack very slowly till the scale beam raises.

The beams I am using are 3 in. by 3 in. effective section, with 1¼ in. of concrete below the center of the steel. The steel is a ¾ in. round bar. They are built 5 ft. 6 in. long and tested on a 60 in. span, the load being applied 20 in. from each end support The concrete for them is mixed according to the curve of maximum density, from local gravel and sand, a mechanical analysis of the materials being made for each beam. Enough cement is used in all cases to fill the voids in the mixture as determined by experiment, allowing 3 per cent. extra. I am not satisfied with some of the results and believe that the beams should be at least 90 inches long for 28 day tests, (the above described beams being tested in 28 days) as in some cases the steel slips in the concrete before the beam breaks in compression.

The above system of testing is easy of operation and much quicker than loading and unloading a platform, and can be used right on the work as well as any other.

F. C. Snow.

Asst. Prof. Civil Engineering
Montana State College,
Bozeman, Mont.

Skeleton Reinforced Concrete Construction

The article by F. W. Wilson in the February Cement Age is interesting and suggestive, even though we cannot all agree with everything stated therein. There seems, to the writer, to be some good points in Mr. Wilson's design but it might be materially altered and, as the writer thinks, improved by the following changes:

Instead of brick curtain walls, tile might be used with some economy and considerable reduction in weight.

Instead of filling the panels between the reinforced concrete beams with tile, it would be more consistent, better, and cheaper to fill them with separately-molded reinforced-concrete slabs of con-

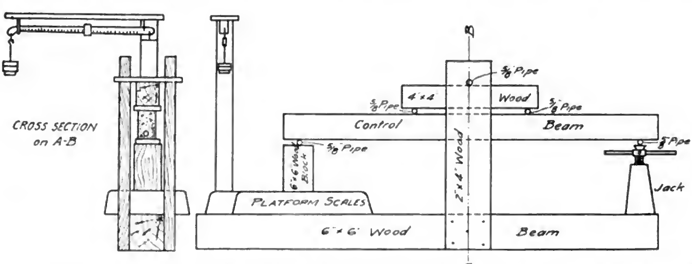


DIAGRAM SHOWING ARRANGEMENT OF PLATFORM SCALES TO TEST CONTROL BEAM.

venient size. The beams and girders, in such a design, would be provided with seats or bearings for the slabs and the slabs might be made of standard dimensions.

Should it be necessary to cut a hole in the floor after the building is finished, it would only be necessary to take out one or two slabs.

This construction, I believe, would be nearly, if not quite as cheap, as that suggested by Mr. Wilson, and taking into account the substitution of tile for brick in the curtain walls, I believe, it would be quite as cheap and far better.

These suggestions are scarcely entitled to the term invention, and the writer desires no credit whatever for them, but is desirous that whatever merit they may possibly have shall be open to the free use of the engineering and architectural professions.

A. W. Buel.

Consulting Engineer, New York.

Early Flat Slab Construction and the Patent Situation

I have been to a certain extent interested in Mr. Turner's apparently successful attempts to secure a patent of slab construction in reinforced concerte along the lines which I believe were anticipated by me, buildings erected and results published some years in advance of any attempt by Mr. Turne.r

Briefly, in 1896 I purchased sheets of celluloid ⅛ in. thick with which I made crude experiments to determine the probable carrying capacity of slabs which were to be composed of reinforced concrete in which steel should supply the necessary tensile strength, being placed in the bottom or top of the slabs respectively as circumstances required.

These experiments indicated a safe carrying capacity six times greater that evidenced by the same material when treated and loaded as a beam supported at two points.

They were mentioned by me at various times to members of the American Society of Civil Engineers and a brief reference made to the advantages of continuous slab construction on the bottom of page 660 of the transactions of the American Society of Civil Engineers, volume No. 39, June 1898.

During the summer of 1898, I built a full size section of floor, reinforced with expanded metal in the bottom of the slab at certain points, and in the top of the slab at certain other points, loaded and tested it for the purpose of demonstrating its utility in a building which I then expected to erect.

This building did not go ahead, but in 1900 I erected a building in which this principle was worked out and successfully applied, the floor slabs being continuous over all supports, the reinforcement applied to provide the requisite tensile strength to the slab, and the results published in the *Railway Gazette* of December, 1901, and January, 1902.

No application was made by me for a patent on this construction as it seemed to me but the application of well established engineering principles which were not generally well understood by engineers. Every essential point made by Mr. Turner in his patent which has been issued was anticipated by me in these constructions.

Geo. Hill.

Consulting Engineer,
New York City.

Reinforced Concrete Skeleton Frames

In regard to the article on this construction in your February issue, Fig 1 (page 79) shows a cross-section of a girder, and not a beam as stated. The floor plank as shown in Fig. 2, are run at right angles to the *beams*. They would of necessity have to run parallel with the length of the girder, and, therefore, require screeds in the cinder concrete to which the plank are nailed. *No* screeds are used in the beams, as the plank are run transversely to the spiking pieces and plank are therefore nailed to the spiking pieces.

As regards the first of the editorial comments, I would simply call your attention to the fact that in one year's time almost $8,000,000 was spent in constructing factory buildings in the city of New Bedford alone, and not one factory building was built of reinforced concrete. The percentage of factory buildings constructed of concrete in New England is ridiculously small, even at the present time as compared with the factory buildings of mill construction.

As regards your second editorial comment, I certainly do not wish to retract anything said in regard to granolithic floors, and the satisfaction they give as a wearing surface for factory floors. I will, of course, admit that a good, first-class job of this description is often satisfactory, but the percentage of floors of this kind which do not give satisfaction is very high, as can readily be learned from factory owners themselves, by any one who takes the trouble to investigate. My statement did not criticise the durability of *all* floors of this description, but was moderate to the extent of stating that "at times" the floor finish would not stand the wear of running hand-trucks over, and that it was "no uncommon thing" for the top surface to dust up. These statements are certainly moderate and do not, of course, apply where such conditions have not developed, but I believe that investigation would show that a majority of the granolithic finish floors for factory buildings are unsatisfactory to the owners after they have been used for a reasonable length of time.

Francis W. Wilson,

Consulting Engineer,
Boston, Mass.

Steel in the Proposed New York Building Code

Our attention has been called to the provisions of the proposed new Building Code of the City of New York relating to concrete reinforcing steel. We are much surprised to note that by this new code all hard-grade or high-elastic-limit steel is eliminated, whether rolled from rail-steel or new billets.

This is very unusual. We do not recall any code in effect among the larger cities of this country which prohibits the use of this class of reinforcing material. It is apparent that the restriction as relates to hard-grade steel is intentional, but we are somewhat at a loss to know whether it was also the intention of the framers of this code to eliminate cold-twisted bars from medium steel, and deformed bars as well.

If we interpret sections 113 and 64 correctly, a maximum ultimate strength of 6,500 lb . per sq. in. is required. Cold-twisted bars will not meet this requirement, nor will they meet an elongation of 22 per cent. in eight inches. Few, if any manufacturers of mild steel deformed bars would essay to guarantee their product to meet these specifications; at any rate, their present specifications do not accord with these provisions.

The apparent purpose of the new code as we construe its requirements, is to limit reinforcing steel to plain round or square bars of soft or medium steel. This is so contrary to present engineering preference and practice, that we incline to the belief that our construction of the code is not what the framers intended. It is possible that they did not appreciate that in attempting to make their specifications for structural steel cover reinforcing steel also, they have effectually eliminated those grades which are most largely used in modern reinforced concrete design.

It seems to us that the code committee has absolutely ignored the well recognized fact that reinforcing steel performs a radically different function from that required of structural members.

They have ignored all existing specifications formulated by other commercial or technical bodies. They omit entirely one requirement which ordinarily is considered most vital, namely, the bending test for ductility. They require no determination of chemical properties. In short they disregard. or dismiss as inconsequential, all the recent conclusions arrived at by those who have made the science of concrete reinforcement one of the most marvelous developments of the present age.

We, as manufacturers of reinforcing rolls from rail-steel, might perhaps be expected to take exception to that portion of the proposed code which limits the process of manufacture to material rolled from new billets. Inasmuch, however, as all steel of the hard grade is eliminated, irrespective of how it is produced, we have no grounds for complaint on that score. What we would be glad to learn, however, is the points which the code committee took into consideration in arriving at a determination to bar out all hard grade material of high-elastic limit.

We believe that your readers would be interested in a discussion of this subject and we trust that either editorially or through your correspondence columns, you may be able to throw a little light on the question.

L. W. Barnette.

Secretary The Franklin Steel Co.,
Franklin, Pa.

Testing Concrete Materials

The National Association of Cement Users, through their Committee on Specifications and Methods of Tests for Concrete Materials, are investigating the problem of testing sand and other aggregates for use in Portland cement mortar and concrete to determine their suitability for such use. This committee desires to get into communication with all laboratories who are now testing sand and other aggregates, and to secure their co-operation with the committee in formulating standard tests for these materials. The committee is particularly anxious to secure samples of sand which appear suitable for use in concrete, but in practice prove unsuited. The committee would welcome communications from all interested in the subject who are willing to co-operate in this work to the extent of furnishing data obtained in their laboratory or field practice, or of recommending forms of tests which may be considered by the committee. Communications should be addressed to Cloyd M. Chapman, care of Westinghouse, Church, Kerr & Co., 10 Bridge St., New York.

(Signed)

Committee on Specifications and Methods of Tests for Concrete Materials.

Sanford E. Thompson, Chairman.
William B. Fuller,
R. S. Greenman,
Arthur N. Talbot,
Cloyd M. Chapman, Secretary.

SELLING FORMULAS AND OXY-CHLORIDE CEMENTS

It is to be regretted that certain parties have been able to play on the credulity of the public and revive the old time graft of selling formulas for certain new and wonderful methods and processes for the manufacture of artificial stone and imitation marble. It is well known to persons informed on the subject, that there is no Portland cement used in the making of these imitation marbles, and it is a fraud to so represent. Many of the buyers of the formulas are men who are actively engaged in the manufacture of honest Portland cement products, and can ill afford to spend their money for a formula that is worse than useless to them.

If a party should buy a formula on the representation that Portland cement was the cementing material used, and later find that there is no Portland cement in the mixture, should he not be able to recover the amount he paid for the formula?

Most of the formulas are based upon the discovery of a Frenchman about 1854 and patented by him in France under the name of "Sorel's Artificial Stone." Since that time many "fakirs" have benefited by selling the knowledge of the setting quality of certain materials, and there has been a general revival in the industry of formula faking in the United States in the last ten years. Each fakir has solved the mystery of how to handle the compound and get results that the others have been unable to obtain.

To a thinking man this question occurs: If this is such a wonderful material, why are there no successful plants in operation using it? Certainly since 1854 there has been time enough to develop a few successful businesses founded on the formula if there is any merit in the material.

A. G. Higgins.

Kansas City, Mo.

Note.—The points raised in the letter from Mr. Higgins should be carefully considered by all concrete men. Artificial marbles are a most fascinating possibility, and the exhibits at past Cement Shows have been centers of interest. Investing money for the privilege of attempting to duplicate this product is, however, another question.

"Scagliola" is probably the best known of the artificial marbles. Of this there are two grades, the coarse being used as the under coating and the fine as the upper coating. On this upper or outer coat is applied the colors used in making these beautiful artificial marbles, made to imitate all kinds and descriptions of marble. These materials, however, are gypsum compounds treated with alumina or silica and boiled together. These gypsum compounds harden rapidly and attain great strength. Similar material, made by nature, is found out in Kansas where gypsum beds have been impregnated with silica and alumina in varying proportions.

The above method for the making of artificial marble is well recognized and Keen's cement has an established reputation. It sells for from four to eight dollars per barrel, *but has no relation whatever to Portland cement.* Users of this material are well aware that the resultant product above described is for indoor use only, though briquettes of both the artificial and the natural Parian cements have been subjected to water and have given excellent results. The fake compounds are those composed of pulverized silica and chloride of magnesium. These secrets have been sold for many years by various people to different companies upon the assumption that some wonderfully hard material could be made similar to Portland cement concrete and stand the same exposures.

In Philadelphia, about fifteen years ago, the Silexite Company did a large business for a time in the preparation of artificial stone made with finely pulverized white sand and chloride of magnesium. The secret consisted in a particular method of compounding the ingredients. Quite an amount of capital was enlisted with the enterprise and a large works was established where all sorts of tile, slabs, etc., for interior decoration were produced. Columns were also produced for architectural purposes and wonderfully brilliant surface decorations were printed or stamped upon the material. The company also attempted to supply the stone for exterior use, making sills, lintels, door-jambs and other similar architectural decorative details. In the presence of moisture and rain the material disintegrated at long periods and had to be replaced and the company wound up its operations. The history of this company is no doubt duplicated in many other cities where formula fakirs, basing their knowledge on Sorel's original discovery and upon such discoveries as detailed above, have sold their recipes and in many cities companies have been organized to operate under formulas of the character described and have doubtless found endings similar to that of the Silexite Company.

By referring to Eckel's "Cements, Limes and Plasters,"* pages 162 to 167, a complete discussion of oxy-chloride cements will be found. We quote from this in abstract as follows:

Oxy-Chloride Cements.—In 1853, the chemist Sorel discovered that zinc chloride, when mixed with zinc oxide, united with it to form a very hard cement. Later it was discovered that the same held true of a mixture of magnesium chloride and magnesia. The product in both cases is the same—an oxy-chloride of zinc or magnesium respectively. Chlorides and oxides of several other elements possess this same property, but it has been utilized commercially only in the cases of the zinc and the magnesium compounds. Of these, zinc oxy-chloride is extensively used as a stopping by dentists. Magnesium oxy-chloride, called commonly Sorel cement

*"Cement, Limes and Plasters," by Edwin C. Eckel. Editions 1909. John Wiley & Sons, New York.

or magnesia cement, has more important technical uses.

The commercial magnesium chloride used in the preparation of Sorel stone, etc., usually contains sulphuric acid. As this acid and its compounds spoil the appearance and the durability of the stone produced, it is eliminated from the magnesium chloride by treatment with barium hydrate or barium carbonate. In practice, the magnesium chloride is dissolved in water to form a solution of 20° to 25° Baume, and the barium hydrate or carbonate is added by degrees and carefully stirred until the precipitate of barium sulphate ceases to increase. The amount of reagent required is usually between 6 and 10 per cent. of the weight of the magnesium chloride treated.

Magnesia cement is used very extensively as a binder, in connection with briquetting, in the manufacture of artificial building stones, tiles, grindstones, and emery and polishing wheels. Its binding quality is very considerable, and it is very plastic and cheap. A good mixture for this use consists of 25 parts of magnesium chloride (45 per cent. solution), 25 parts magnesia (93 per cent. MgO) and 50 parts water. About 5 lbs. of this mixture will serve to cement 95 parts of stone, emery, etc.

Gilmore, in 1871, prepared a report on certain American patented products based upon Sorel cements. As this report is still the only complete discussion of the subject, it is printed below almost verbatim.

"The several steps in the process, beginning with the raw magnesite, are briefly as follows, viz.:

"First. The magnesite is burnt in ordinary lime-kilns, and at a dark cherry-red heat, for about twenty-four hours. The result is protoxide of magnesium, which is next ground to fine powder between horizontal millstones, furnishing what the Union Stone Company style "Union Cement."

"Second. For making stone, the burnt and ground magnesite (oxide of magnesium) is mixed dry in the proper proportion with the material to be united; that is, with powdered marble, quartz, emery, silicious sand, soapstone, or with whatever substance forms the basis of the stone to be imitated or reproduced.

"The usual proportions are: for emery-wheels, 10 to 15 per cent. of oxide of magnesium by weight; for building-blocks, such as sills, lintels, steps, etc., 6 to 10 per cent., and for common work for thick walls, less than 5 per cent.

"The dry ingredients are mixed together by hand or in a mill. A hollow cylinder revolving slowly about its axis would answer the purpose.

"Third. After this mixing they are moistened with chloride of magnesium, for which bittern water—the usual refuse of seaside salt works—is a cheap and suitable substitute. The moistened material is then passed through a mill, which subjects it to a kind of trituration, by which each grain of sand or other solid material becomes entirely coated over with a thin film of cement, formed by a combination of the chloride with the oxide of magnesium. The bittern water is required to be of the density of 15° to 30° Baume. The mass on emerging from the mill should be about as moist as molder's clay. The mixing machine used by the Union Stone Company is an improved pug-mill invented by Mr. Josiah S. Elliott. It is represented as an excellent mill, doing its work thoroughly.

"Fourth. The mixture is formed into blocks by ramming or tamping it in strong molds of the required form, made of iron, wood, or plaster, precisely as described in paragraph 24 Report of Beton Agglomere. The block may be taken out of the mold at once, and nothing further need be done to it. The setting is progressive and simultaneous throughout the mass, as with other hydraulic cements, and requires from one hour to one day, depending somewhat on the chemical properties of the solid ingredients used, the carbonates as a rule requiring a longer time than the silicates.

"Building blocks will bear handling, and may be used when three or four days old, although they do not attain their maximum strength and hardness for several months. Emery wheels are not allowed to be used in less than four weeks.

"This stone so closely resembles the natural stone, whether marble, soapstone, sandstone, etc., from which the solid ingredients are obtained by crushing and grinding, that it is difficult, without the application of chemical tests to detect any difference in either texture, color, or general lithological appearance.

"Strength. In strength and hardness this stone greatly surpasses all other known artificial stones, and is equaled by few, if any, of the natural stones as adapted to building purposes. The artificial marble takes a high degree of polish, being in this respect fully equal to the best Italian varieties.

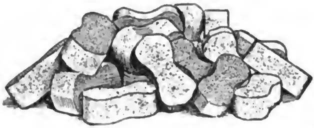
"Some trials of 2 in. cubes at the Boston Navy Yard gave the following results, reduced to the crushing pressure upon one square inch:

No.		Lbs.
1	—Crushing strength per sq. in.......	7,187½
2	—Crushing strength per sq. in.......	11,562½
3	—Crushing strength per sq. in.......	21.562½
4	—Crushing strength per sq. in.......	7,343½

"In none of these samples did the proportion of the oxide of magnesium exceed 15 per cent. by weight of the inert material cemented together This statement is derived from the treasurer of the company."

"If this is such a wonderful material, why are there no successful plants in operation using it?" The question from Mr. Higgins is very much to the point; one which might be asked on many occasions. Artificial marbles do not, to the best of our knowledge, have any relation to Portland cement; there is very little about their composition that is not known to the technical world, and is common property; and in sixty years since the discovery of oxy-chloride cements, while there have been many companies apparently successful for a time producing this material (Mr. Gilmore mentions the Union Stone Co., and note also the Silexite Co.), yet there seems to be somewhere a point of weakness proving fatal to its successful use.

CEMENT AGE believes, therefore, that the entire matter should be gone into carefully, and we will be glad to have complete data on any successful or unsuccessful endeavors in this field, that some of the mystery which has so far cloaked this field may be lifted. Further comment is invited.—THE EDITORS.



BRIQUETTES

MONTHLY COMPARATIVE TABLE

Imports of Portland, Roman and Hydraulic Cements.

Country	Month of Mar., 1911 Barrels	Value	Month of Mar., 1912 Barrels	Value
United Kingdom	......	......	126	$ 219
Belgium	4,934	$ 5,926	......	......
Germany	1,968	2,766	778	886
Canada	......	......	34	76
Other Countries	893	1,551	......	......
	7,795	$10,243	983	$1,181
Less Foreign Cement Exported	......	......	104	166
	7,795	$10,243	834	$1,015

Decrease in imports during the month of Mar., 1912, as compared with Mar., 1911 . . . . . . 6,961 barrels

Country	9 Months Ending March, 1911 Barrels	Value	9 Months Ending March, 1912 Barrels	Value 0
United Kingdom	21,667	$ 24,567	24,871	$30,29 5
Belgium	76,894	95,824	5,147	5,93 9
Germany	44,946	63,655	56,292	89,72
Canada	379	963	105	22
Other Countries	14,590	21,191	8,424	13,04
	158,476	206,200	94,839	139,218
Less Foreign Cement Exported	14,994	19,015	3,187	6,064
	143,482	187,185	91,652	133,154

Decrease in imports during 9 mos. ending Mar., 1912, over 9 mos. ending Mar., 1911 . . . . 51,830 barrels

Imports of Portland Cement into the U. S. during March, 1912 by Districts

District	Barrels	Value
Boston	126	$ 219
New York	677	755
Porto Rico	101	131
Minnesota	30	67
Oswegatchie	4	9
	938	$ 1,181

Exports of Cement

Exports of cement, month of Mar., 1911—269,003 bbls., value $383,403

Exports of cement, month of Mar., 1912—347,829 bbls., value $521,089

Increase in exports, month of Mar., 1912, over month of Mar. 1911 . . . . . 78,826 barrels

Exports of cement, 9 mos. ending Mar., 1911, 2,149,979 bbls., value $3,113,567

Exports of cement, 9 mos. ending Mar., 1912, 2,369,403 bbls., value $3,502,054

Increase in exports during 9 mos. ending Mar., 1912 over 9 mos. ending Mar., 1911 . 219,424 barrels

A CONCRETE WATER TANK AT VICTORIA, AUSTRALIA.

Reinforced Concrete Water Tank

A water tank which claims attention on account of its queer shape was recently completed in Victoria, Australia. The illustration shows the funnel shaped design of the tank, which has a capacity of 90 cu. m. (3150 cu. ft.) The lower section is of brick, while the upper portion is reinforced concrete. Reinforcement consists of radial and ring shaped steel rods of 9.5 mm. (0.83 in.) diameter, fastened together at points of intersection with 1.5 mm. (0.6 in.) wire. The concrete was mixed of 2 pts. basalt rock; 3 pts. finer screened basalt: 1 pt. cement.—*Beton und Eisen.*

The flood elevation projects at Pittsburg require considerable Portland cement for foundations under streets, curbing and for new sidewalk work, to say nothing of new concrete walls for supporting old buildings and for use in the erection of new structures justified by the improvement of property. Several large concrete sewers are in course of construction in Pittsburg, including the Negley Run sewer which will take over 10,000 barrels of cement and the Try Street sewer which has taken about 4,000 barrels; and also a sewer under the P. C. C. & St. L. R. R. tracks being constructed in connection with the elimination of grade crossing at Second Avenue in which about 3,000 bbls. will be used. Additional improvements of this kind are in contemplation, but it is a difficult matter to tell at this time what the cement requirements will amount to.

FOREIGN NOTES

Translations made especially for CEMENT AGE by F. W. Scholtz

Ice Palace in Hanover

The roof construction of the ice palace offers some points of interest. Nine rafters carry the barrel arch roof the thrust of which is sustained by a tensile thrust bar beneath the floor of the skating rink. The panels between these rafters form a thin interior reinforced concrete ceiling. This light ceiling is a continuation of the compression slabs of the barrel arch rafters, and is finished in such a way as to form one complete unit with the same. The second reinforced concrete roof which rests on the square rafters of the barrel arch is much stronger in construction, and is covered with a layer of waterproof felt. The crown of the arch is covered with a wire glass transom running the entire length of the building, and is used for ventilation. The illustration shows the construction of the roof. The layer of air enclosed between the outer and inner reinforced concrete roofs acts as an insulating material and makes the inside temperature more or less independent of the outside temperature.

FIG. 1—ROOF CONSTRUCTION AT THE ICE PALACE, HANOVER.

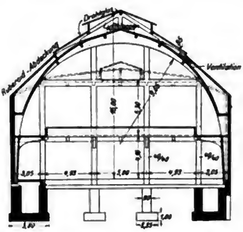
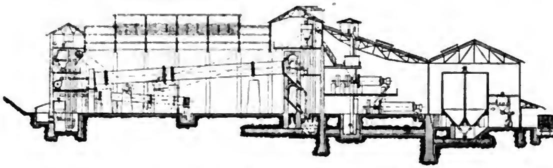


FIG. 2—CROSS-SECTION ICE PALACE AT HANOVER.

The construction of the hall was very difficult owing to marshy ground. The time taken for the foundations was longer than anticipated and special efforts had to be made to hasten the rest of the construction so as to finish the building in contract time. The construction of the rafters is of great interest. The reinforcement for the same was fabricated at the steel shops up to about half the height of the bend of the arch, and put together so that the entire unit was rigid. Fig. 2 shows one of these rafter reinforcements in place and ready for concreting. The heavy round steel rods were fastened to heavy angle iron frames by means of screw hooks, and thus kept in position. Then the entire skeleton was raised in position and concreted. The building was finihed within two and one-half months, including the excavations for foundations.—*Armierter Beton.*

The Action of Copper, Lead and Zinc on Cement, Concrete and Fluids

The first series of tests was to show what action copper, lead and zinc take when in contact with aqueous solutions, which are in contact with cement or concrete. The tests extended from one month to one year. In the second series of tests the metals were imbedded in cement cubes and left in water for some time. Metal sheets of only 0.06 in. thickness were used. The liquids tested comprised distilled water, faucet water, solutions of calcium hydroxide, calcium carbonate, calcium bicarbonate, gypsum, artificial seawater, cement water, which was obtained by mixing cement with distilled water, and with water in which cement powder was used as sediment. The results show that attacks on the metal decrease in violence if the air has no access. As regards the results of the metals imbedded in cement cubes, it was found that copper suffers less in this connection than when exposed to the action of cement water. Lead imbedded in cement is attacked violently. The most interesting result is in the action of cement on zinc, in which it adheres to the cement, due to a chemical reaction, since the zinc also showed a layer of cement particles, which could not be rubbed off.—*Armierter Beton.*



CROSS-SECTION OF CEMENT PLANT AT ELM, GERMANY.

Portland Cement Plant at Elm

The accompanying illustration shows a cross section through the kiln plant of the Portland cement plant at Elm. Coal dust and also lignite briquets are used as fuel. The coal is ground to coal dust in the tube mills, after it has been dried in the coal drying plant. The clinker leaving the cooling drum, passes to crushers by means of endless belts, and from there to the tubular mills. Next to these mills is the large cement silo.—*Tonindustrie Zeitung.*

The Austrian state railways have recently completed the construction of a 240 m. (792 ft.) long reinforced concrete viaduct, the first of its size in that country.

Recent analyses in European laboratories have shown that ordinary Portland cement contains small quantities of iron, which are in many instances due to the small iron splinters from the tubular and crushing mills when grinding the cement. The quantities varied, running as high as 0.027 g. iron in 100 g. cement.

Question No.: How to utilize exhaust gases for drying purposes.

Answer: Fig. 5 shows the kilns to have four parallel conduits, running parallel to the five kilns, through which the exhaust gases were to be sent alternately by the different kilns. The chimney was to be separate at some distance from the kilns.

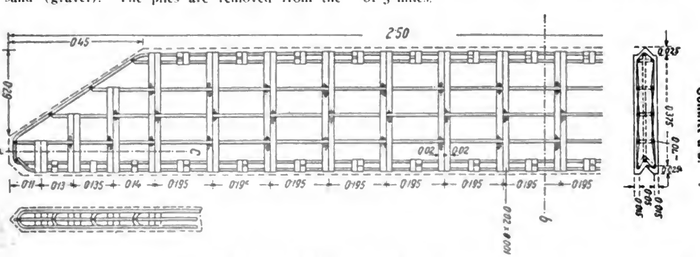
Reinforced Concrete Sheet Piling

Reinforced concrete for sheet piling has been used for some time in Holland and given excellent results. Fig. 7 shows a section of such a sheet pile, where the reinforcement is plainly shown. The piles are tamped lying on their sides, being made of 1 part cement; 2 parts sand; 3 parts fine river sand (gravel). The piles are removed from the mould after two days setting, and left to set for one month, when the piles can be rammed, using a wooden ram of 350 kg. (770 lbs.) weight falling from a height of 1 m. (3.3 ft.) Where the ground into which the piles are driven is stony, the points must be protected with iron sheeting.

Reinforcement consists of 12 long steel rods of 8 mm. (0.3 in.) diameter, two of which are twisted into one rod for the reinforcement. The stirrups are of band iron instead of round rods, and the cut shows how the longitudinal rods are interwoven with the band iron to give the greatest strength. The length of these piles is 2.5 m. (8.3 ft.—*Beton und Eisen.*

Dr. von Emperger recently published his tests on the use of cast iron columns in connection with reinforced concrete construction and bridge building, in which he showed that such iron columns used as cores for reinforced concrete columns, with hoop reinforcement, gave excellent constructive parts, and allowed great changes in form without breaking, in addition to the fireproof qualities, which the iron columns without concrete reinforcement cannot claim.

A reinforced concrete motorboat of 25 ft. length and 6 ft. wide has recently been constructed in Germany. The motor rests on a wooden bed, which in turn rests on concrete beams. A mould was made, the steel reinforcement placed, and the concrete poured. After setting, both the inside and outside were carefully polished. The outside of the boat was painted with magnesium sulphate, and finished with another coating of oil, and then rubbed off with oil, pumice and sawdust. A 5 h.p. motor propelled the boat, which can attain a speed of 5 miles.



DETAIL SHOWING REINFORCEMENT OF CONCRETE PILE.

RECENT PUBLICATIONS

A Correction

Building Stones and Clays, by Edwin C. Eckel, was listed in the May issue and due to a typographical error, the price was quoted at $30.00 instead of $3.00.

Technologic Papers of the Bureau of Standards. By Richard L. Humphrey and Louis H. Losse. S. W. Stratton, Director. Published by the Government Printing Office. No. 2, "The Strength of Reinforced Concrete Beams." Results of tests of 333 beams. 7 x 10 inches; paper bound; 200 pages; illustrated.

The John Willy Hotel Directory, 1912. Published by the *Hotel Monthly*, 443 South Dearborn St., Chicago, Ill. 3 x 9 inches; cloth bound; 177 pages. Price $1.00.

Concrete Costs. By Taylor and Thompson. Published by John Wiley & Sons, 43 East 19th St., New York. 5 x 8 inches; cloth bound; 709 pages; illustrated. Price $5.00.

Arch Design; Specialization and Patents. Daniel B. Luten, M. W. S. E. Presented June 10, 1912, before the Bridge and Structural Section Western Society of Engineers, Monadnock Block, Chicago, Ill. 6 x 9 inches; paper bound; 45 pages; illustrated.

Concrete and Stucco Houses. By Oswald C. Hering. Published by McBride, Nast & Co., Union Square, New York. 7 x 10 inches; cloth bound; 105 pages; illustrated. Price, $2.00 net. Postage 20 cents.

This book is a strong plea for more durable and carefully thought-out methods of dwelling construction. It is handsomely bound, printed and illustrated, the pictures and plans including landscape features as well as structural details. The author not only urges sound construction, but advocates an excellent idea in urging that room and comfort should not be sacrificed to convention, that is to say, a house of moderate size should not be cut up into many rooms merely because it is customary to have a stipulated number. The volume, which contains a little over a hundred pages, should be instructive and interesting to architect and layman alike. On the subject of concrete and stucco the author goes into detail as to proper methods of mixing and placing, showing how to obtain the best results in color, texture and wearing qualities.

Reinforced Concrete Design. By Oscar Faber, B.Sc., A.M.I.E.E., A.C.G.I., Chief Engineer to Trollope & Colls, Ltd., and P. G. Bowie, A.C.G.I., Assistant Engineer to Trollope & Colls, Ltd. Published by Longmans, Green & Co., New York, and Edward Arnold, London. 8½ x 6 inches; XIX+317 pages; cloth; 160 figures in the text. Price $3.50 net.

This book is the first exposition of a number of very important considerations in the design of reinforced concrete structures that has appeared in print. Previous authors have apparently neglected the fact that the stresses in a monolithic structure of reinforced concrete are not governed by the same laws that apply to a built-up structure. The authors of this work have presented formulæ which take the monolithic character of the concrete structure into account; these conditions are necessarily complex for some conditions of loading, and while the "authors admit being unwilling devotees in the temple of mathematics," they have as far as possible concentrated the involved calculus in an appendix. At the same time they have shown marked consideration for those readers who for lack of exercise in the mathematical gymnasium are unable to perform the double back somersaults indulged in by those who are so anxious to display their agility that they forget that there are many brilliant engineers who would appreciate the simple step by step method which is less difficult to comprehend. In this respect the authors are to be congratulated upon the clear and logical analysis which they present of the various stresses in reinforced concrete structures, as well as the thoroughly practical nature of their line of reasoning. In theory the concrete stress should equal the steel stress in a beam; in practical design the steel stress is the governing one in view of the fact that the elastic limit of the steel is its stress limit instead of its ultimate tensile stress. The authors likewise bring forth the well known practical consideration that structural concrete cannot be rammed but must be worked or spaded to bring up the air bubbles and to force the material between and around the steel.

In taking up the computation of stresses the authors state that they propose to run over the elementary sections of this subject as rapidly as possible, since an engineer acquainted with the general principles of the design of structures will have no difficulty in following them, while the secondary stresses, particularly in columns will be more fully dealt with. For amplification of the elementary section they refer the reader to other elementary books and then proceed to give one of the clearest and most logical expositions of the simple stresses that it has been the fortune of the reviewer to peruse. The language is simple and plain and the line of reasoning is completely given and all side issues are eliminated. Adhesion and shear stresses are analyzed in a manner which leaves very little to be desired.

Column stresses have in many cases been considered as very simple problems in reinforced concrete design. The authors of this book, however, present the subject of secondary stresses which in addition to the direct stresses are present in columns. As it is obviously impossible to construct an absolutely rigid structure, it is impossible to avoid some secondary stress, particularly where the entire structure is tied together and the beams and columns are continuous. The authors present the theoretical analysis governing these stresses for a number of different conditions of loading and partial loading and their mathematical analysis is to be commended.

This portion of the work and that devoted to continuous beams are the best treatments of these difficult subjects which have come to the eyes of the reviewer. The formulæ given in the text are simple and the analysis by which these formulæ are derived is given completely in the appendix.

An incidental feature of the work is the use of some extremely good details showing typical reinforcing of girders and columns, Figs. 2 and 99 in particular.

In part IV the authors take up a variety of structures and applications of concrete, and while the treatment is brief it is vital with good horse sense. The specification suggestions are especially good. The 1911 R. I. B. A. report upon reinforced concrete is included in the appendix.

The authors have made a most noteworthy addition to the literature upon reinforced concrete.

CEMENT PRODUCTS EXHIBITION CO.; THE CHICAGO CEMENT SHOW

The annual meeting of the stockholders of the Cement Products Exhibition Co. was held at the offices of the company, 72 West Adams Street, Chicago, on May 14. The routine business transacted consisted of the reading of the report of the Treasurer and the election of new directors and officers. The Treasurer's report showed that the expenses of conducting the New York, Chicago and Kansas City Cement Shows were $77,789.29 while the total receipts were $78,729.52, leaving a surplus on the year's operations of $940.24. By vote of the directors, it was decided to expend this surplus on future Cement Shows.

Directors for the ensuing year were elected as follows: Edward M. Hagar, Pres. Universal Portland Cement Co., Norman D. Fraser, Pres. Chicago Portland Cement Co., D. McCool, Pres. Newago Portland Cement Co., J. V. Shove, Sec. Peninsular Portland Cement Co., W. E. Cobean, Sales Mgr. Wolverine Portland Cement Co., B. F. Affleck, Gen. Sales Agt. Universal Portland Cement Co., George S. Bartlett, Universal Portland Cement Co., J. P. Beck, Mgr. Pub. Bureau, Universal Portland Cement Co.

The following officers were elected: President, Edward M. Hagar; Vice President, B. F. Affleck; Secretary-Treasurer, J. P. Beck.

Sentiments were expressed by the directors favoring the continuance of the Cement Shows, the feeling being unanimous that the cement exhibitions which have been held in the past, have contributed a great deal to the advancement of the industry in advertising cement, cement products and cement machinery, and increasing the use of concrete.

The 1913 Cement Show.—It was decided to hold the Sixth Annual Chicago Cement Show in the Coliseum, January 16-23, 1913, but to hold no shows in New York and Kansas City. It is possible that another exhibition will be held at some other point, although nothing was definitely decided upon.

HANDLING CEMENT ON RIVER BARGES

A new departure in the cement industry developed this month when the Atlas Transportation Co. started on its first trip up the Mississippi with a steamer and five barges loaded to the gunwales with Atlas Portland cement from the Hannibal plant. Progressive as is this concern, one not connected with the cement trade would not imagine the strides they have made in the last few years that brings them to the organization of their own fleet of river boats.

Everyone knows cement is being used in large quantities, and train loads leave the mills every day for all parts of the country to supply the cement workers with the material used so extensively for so many of our everyday needs, but it has again been left to the "Atlas" people to mark a new era in the history of cement by conducting a transportation line of their own on the Mississippi.

This line will run up the river as far as St. Paul, and down the river to New Orleans, and have connecting lines for both the Ohio and Missouri Rivers. The large steamer "Josh Cook," flagship of the fleet, will tow a string of barges, leaving one at each distributing point on the way up or down the river. Atlas dealers will get their supply direct from these barges, and the steamer will pick up the empty barges on her return trip to Hannibal, where they will immediately re-fill, ready for the next trip.

The Keokuk Dam, on which about one million barrels of Atlas cement is used and which is a structure second only in importance to the Panama Canal, is being furnished cement by the Hannibal Plant.

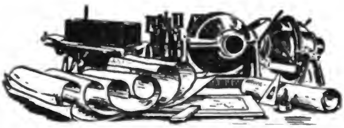
SEATTLE'S 44-STORY BUILDING TO BE BUILT ON CONCRETE PILES

The contract for placing the concrete piles for the foundations of the 44-story office building that is to be erected at Seattle, Wash., for the L. C. Smith Estate, has been awarded to the Raymond Concrete Pile Company of New York and Chicago. This building will be the tallest structure in the world to be built on pile foundations of any kind. It will be exceeded in height only by the Woolworth and Singer buildings and the Metropolitan Tower, all of which are located in New York.

Caisson foundations of the same type as those employed for the aforementioned structures were originally considered in the drafting of the preliminary designs, but, after a careful investigation of the soil conditions and of the types of structures that have been built on Raymond concrete piles during the past decade it was found that piles of this type would constitute a foundation equally as secure as caissons and effect an economy of over $150,000.

The concrete piles will be of the standard Raymond type, made by driving a tapering sheet steel shell by means of a steel mandrel, withdrawing the mandrel after the desired penetration has been obtained and thereupon filling the shell with concrete.

Messrs. Gaggin & Gaggin, of Syracuse, N. Y., are the architects of the Smith building; The Whitney Company, of New York, the general contractors, and Mr. Christian J. Jeppesen the special consulting engineer for the foundations.



PATENTS

1,023,798. Railroad Tie. David S. Beach, Bridgeport, Conn.

1,023,946. Sectional wall contruction. Samuel Solomon Levy, Boston, Mass.

1,024,260. Spacing and supporting device for reinforcing bars. Harvey H. Hickman, St. Louis, Mo., assignor to Corrugated Bar Company, same place.

1,024,276. Building-block. Alfred S. Nash, Wilbamansett, Mass.

1,024,318. Evener bar. Elmer Duschen, Silver Springs, N. Y.

1,024,312. Concrete structure stiffener. William J. Connell and Alfred F. Dickey, Huntington, W. Va.

1,024,357. Mold. Emil Pfeifer, Mascoutah, Ill.

1,024,464. Cement-pipe stamping machine. W. Lothar Velten, Weil-im-Dorf, Germany.

1,024,471. Burial box. William J. Drummond, Philadelphia, Pa.

1,024,646. Mold for concrete curbs for graves. Jeremiah Muckey, Gorin, Mo.

1,024,663. Reinforcement. Asher Atkinson, New Brunswick, N. J.

1,024,761. Load-supporting column for building structures. Adolf F. Anderson, Chicago, Ill.

1,024,852. Per Holmberg, Glencoe, Ill., assignor of one-half to Arthur G. Leonard, Chicago, Ill.

1,024,953. Combined tie and rail-fastener. Edward Stack, Pittsburgh, Pa.

1,025,035. Pipe-making machine. Arthur C. Tunison, Boise, Idaho, assignor to Atlas Cement Pipe and Machinery Co., same place.

1,025,036. Concrete building. Claude A. P. Turner, Minneapolis, Minn.

1,025,041. Ferroconcrete ribbed ceiling. Julius Heinrich Albert Wrissenberg, Bremen, Germany, assignor to The Firm of Gebruder Bolken, Eisenbeton-Hohldecken-Patente "System Wrissenberg," same place.

1,025,112. Method of concreting piles. Alfred H. Davis, St. Petersburg, Fla., assignor, by mesne assignments, to International Concrete Piling Co., Inc., Jamestown, N. Y.

1,025,136. Molding machine. Victor W. Gruman, Zanesville, Ohio.

1,025,290. Screen for screening or sifting sand, gravel, stone and other matters. Edward New, Hamilton, Ontario, Canada.

1,025,330. Wire clip for concrete construction. Josept H. Straus, Jr., Baltimore, Md., assignor of one-half to Raymond H. Williams, same place.

1,025,406. Building block. William H. Koenig, Beloit, Wis.

1,025,434. Concrete piling and piling units. Maxwell, M. Upson, Englewood, N. J.

1,025,462. Mixing machine. Chester T. Foote, Nunda, N. Y., assignor to Foote Manufacturing Co., same place.

1,025,508. Apparatus for making reinforced fence posts of plastic material. Jackson N. Caldwell, Manhattan, Kans.

1,025,536. Tile conctruction for concrete floors. Julian St. John Nolan, Highland Park, Ill.

1,025,579. Molding machine. Luke T. Lowe, Bristol, Tenn., assignor to Diamond Block Machine Co., Bristol, Va.

1,025,663. Tile machine. Cyrus S. Wert, Kendallville, Ind.

1,025,672. Tie and rail fastener. William Beck and Lavergne Beck, Etna, Pa.

1,025,686. Tie and rail fastener. Simon Clary, Carnegie, Pa., and John Butler, Steubenville, Ohio.

1,025,867. Railway tie. Henry G. Filler, Oshawa Township, Nicollet county, Minn.

1,025,907. Mixing machine. Chester T. Foote, Nunda, N. Y., assignor to Foote Manufacturing Co., same place.

1,026,144. Concrete piling. Edward Bignell, Lincoln, Neb.

Good Roads

The Universal Portland Cement Co. call attention in a recent Bulletin to the false economy of building roads on a long time bond issue without proper preparations for maintenance. "Fair treatment of the next generation demands that the roads shall at least give service without excessive maintenance cost until the loan is redeemed." This should be the key-note of the good roads movement. There is no question but that the need for highway improvement is great; there is no question but what it is true economy to build expensive road systems, and yet without serious thought upon the problem of maintenance the most carefully constructed road may prove a financial failure. This is in no sense a criticism of those counties and States where they are now finding macadam to have failed because conditions in the last few years have been entirely changed. Automobile traffic has upset the standards of construction and what was economical, sound engineering five years ago, has under the changed conditions become a wasteful and uneconomical method of construction. Therefore, we must to-day cope with difficulties hitherto unknown rather than condemn the practices of a few years ago as showing lack of engineering skill and foresight on the part of those whose best endeavors went into road construction, wholly in accordance with the best known practice of those days.

HANDLING CONCRETE FOR STREET PAVING BASES

The illustration shows the plan view of an installation used in laying the concrete street bases in Portland, Oregon.

This installation embodied several novel features, and resulted in a great saving in both time and money over the ordinary methods of handling concrete in this kind of work. The raw material was piled on a cross street back of the mixer, and a drag bucket was used to haul the sand, gravel and cement to the mixer.

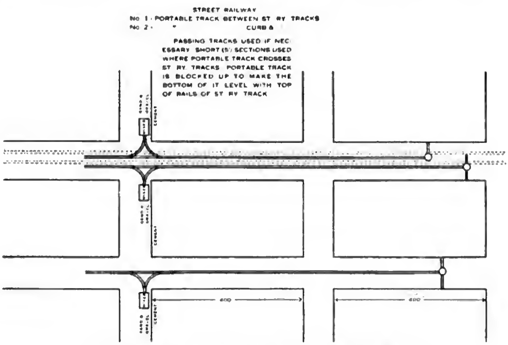
On the streets where there were no railway tracks, portable industrial track was laid down the center of the street, a *Y*-switch leading to the mixer, as shown in the drawing. A turntable was placed at the end of the track, and from the turntable, short sections of portable track were laid at right angles, to the length of the street, and reached to the curb line.

The mixer unloaded directly into steel dump cars, and the cars were then run down the track to the right or left, and the concrete deposited, just where it was needed, requiring very little shoveling. In this way, a section of the street base was laid clear across the street, after which the turntable and cross tracks were moved 6 or 7 ft. back toward the mixer, by merely removing a section of the portable track.

The turntable and portable track were blocked up just enough to permit the cross track to be laid on top of the street railway's rails, so no elevated tracks were required. After the one side of the street, and the section between the railway tracks, was completed, the portable track was moved to the other side of the street and that part of the street completed. Another method employed on streets with double railway tracks, was to lay the portable track on one side of the street, and fill in that side of the street and one of the railway tracks. The portable track was then moved to the other side of the street, and that side and the other railway track filled in. This left a space between the two railway tracks to be filled in which was done by using the turntable and a cross section of portable track which was laying either side of the street.

In all three methods employed, the concrete was dumped away from portable track and as a section of the base was laid, a short section of the portable track was removed and the turntable and cross section of track moved back toward the mixer.

The great advantage of all three methods was that the concrete was placed just where it was needed, and handling the concrete reduced to a minimum.



LAYOUT OF PORTABLE RAILWAY FOR PLACING CONCRETE FOR PAVEMENTS.

On the streets where there were double railway tracks, two different methods were employed in carrying on the work. In both of these methods, the mixer, materials and *Y*-switch were placed as in the method just described.

On some of the streets the portable track was laid the length of the street between the two railway tracks. This method allowed the concrete to be dumped to either side of the portable track, thus filling in the space between the railway tracks. At the end of the portable track, a turntable was placed, from which a section of portable track ran to one curb. This left one of the railway tracks clear, while on the other, when a car came along, the cross section of portable track was very easily lifted up, and replaced after the car had passed.

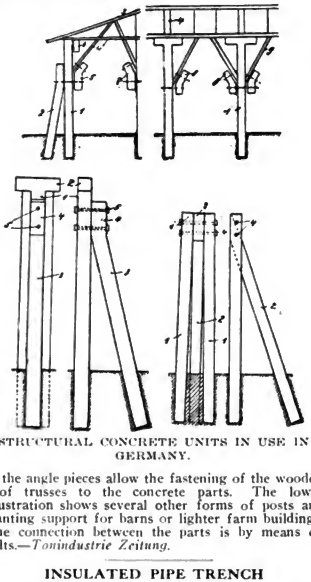
Mr. Wiles, of Portland, Oregon, the contractor in charge of the work, states that he saves so much by this method of handling his concrete, that he will use it on all future jobs. His experience should be of value to other contractors. The equipment for handling this material was furnished by the Orenstein-Arthur Koppel Co., of Pittsburgh.

Attention is called to the announcement in the classified advertising column that the Government of Jamaica is prepared to receive tenders, up to August 31st, for the construction of a reinforced concrete freight pier and sea wall in the harbor of Kingston, Jamaica. Drawings of the proposed work may be inspected and further information obtained at the office of Gillespie Bros. & Co., 11 Broadway, New York.

Concrete Construction Members

Successful tests have recently been made to make concrete structural units like columns and posts, to be used for temporary structures, Exposition buildings, or any temporary buildings in which the columns are simply to sustain the load of the roof can use these concrete columns to great advantage. The illustrations show such concrete units.

The truss work which carries the light roof rests on concrete angle pieces 5, 7 and 8, which are connected to the uprights by long bolts. Openings left



STRUCTURAL CONCRETE UNITS IN USE IN GERMANY.

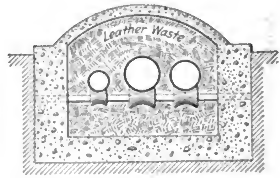
in the angle pieces allow the fastening of the wooden roof trusses to the concrete parts. The lower illustration shows several other forms of posts and slanting support for barns or lighter farm buildings. The connection between the parts is by means of bolts.—*Tonindustrie Zeitung.*

INSULATED PIPE TRENCH

[*From the Engineering and Mining Journal.*]

The trench shown in the accompanying illustration was originally designed for use underground for the purpose of carrying steam pipes without excessive loss of steam through radiation, and to prevent, so far as possible, heating of the drifts through which the pipes pass. The body of the trench is three or four inches thick. The steam pipes are carried on rollers mounted on horizontal cross rods imbedded in the concrete. After the pipes are laid, leather waste, sand or other suitable non-conductor of heat is used as a covering. The trench is covered with concrete one inch thick so that the top can readily be broken into when it is necessary to get to the pipes.

Similar trenches can be used to advantage at the surface for protecting water pipes from freezing in cold weather. There are advantages in not burying water pipes at the surface of a mine: it is frequently necessary to reach the pipes, which cannot be so



SECTION OF PIPE TRENCH.

readily done if they are buried deep enough to be below the frost line.

Depositing Concrete Under Water

Methods of depositing concrete under water have been studied during the past year by the committee on masonry of the American Railway Engineering Association, and certain conclusions on this subject are presented in its report on the basis of replies to a circular sent to a large number of railroads.

It is found that the methods of depositing concrete included in the replies were: Bottom-dump bucket, tremie, sacks, paper bags, open chutes, open depositing, pneumatic grouting or broken stone and concrete blocks.

The committee makes a series of observations in regard to general practice in this matter, which are substantially as follows:

Concrete may be deposited successfully under water, if so handled as to prevent the washing of the cement. Cofferdams should be sufficiently tight to prevent current through the pit, and the water in the pit should be quiet.

The concrete should be deposited in place either by means of a drop-bottom bucket or a tremie, and should not be allowed to fall through the water. Where a bucket is used, it should be carefully lowered to the bottom and raised to the surface, so as to cause as litle disturbance as possible of the water. Where a tremie is used, it should be kept filled with concrete up to the top of the water level, and the discharge end should be kept buried in the freshly deposited mass to prevent emptying, and raised a few inches at a time as the filling progresses. The surface of the concrete must be kept as nearly level as possible to avoid the formation of pockets which will retain laitance.

Where concrete is not deposited continuously, all sediment should be removed from the surface of the concrete, by pumping or otherwise, before depositing fresh concrete. The concrete should be a 1:2:4 mixture and of a quaking consistency. Freshly deposited concrete should not be disturbed.

Where the flow of water through the pit cannot be prevented, concrete should be deposited in cloth sacks.

The Turner Construction Co., have been awarded the general contract for the construction of a nine-story and basement abattoir for Joseph Stern & Sons, Inc. The building will be erected at the foot of West 39th street, New York City, 100 ft. x 100 ft. in plan, of reinforced concrete throughout. The work will be undertaken at once. E. D. Dellmar is architect.

MacArthur Concrete Pile & Foundation Company has been awarded contract for pedestal concrete pile foundations of a large machine shop for the Westinghouse Electric & Mfg. Company., East Pittsburgh, Pa. Prack & Perrine are the architects for this work.